	Title:	Global Supplier Quality Manual
ATS Corporation – Global	Document Number:	C7.4-1M
Global Business Process Procedure	Function:	Global Quality/ Global Supply Chain
	Authorized By:	Global Supplier Quality & Development Manager

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1.0 Scope

The ATS Global Supplier Manual defines the minimum quality assurance requirements and supportive records. The supplier's quality management system shall be registered with an accredited quality system such as ISO 9001. Suppliers that do not have an accredited quality system shall be evaluated by ATS to determine if they meet the minimum requirements of ATS. Additional requirements may be defined by each ATS facility.

The suppliers manufacturing and support locations, including procedures, material, inspection methods, equipment, techniques, facilities, personnel, performance, and documentation are subject to periodic review and by ATS personnel. An evaluation may be conducted prior to issuance of contract, and periodically thereafter to retain the contract.

2.0 ATS Quality Expectations

ATS expects that suppliers will not only meet engineering specifications, but will continuously improve products and services through process performance optimization and through reductions in process variation. ***Quality is defined as providing products and services, which meet the customer's expectations at a cost, which represents value.*** While various ATS functions will assist the supplier in improving quality, ***the responsibility ultimately remains with the supplier.***

ATS will not accept any reconditioned, used, or repaired items unless otherwise specified contractually by ATS. Other conditions such as Control of Counterfeit, Fraudulent and Substandard Items shall be stipulated by ATS divisional requirements.

The Supplier shall not substitute other items for the items requested without specific written approval of ATS prior to shipment. If the Supplier identifies changes, nonconformance's, or seeks waivers from other requirements of this Purchase Order, the Supplier shall describe such conditions and this information shall be transmitted in writing to ATS. If the requested information is approved by ATS, the Supplier shall include an approved copy of the information statement with the items shipped.

The Supplier shall identify any change made to upgrade any item on the purchase order as a result of ATS request or Regulatory correspondence (such as information notices, bulletins and advisory letters).

Significant changes as part of the Supplier's product improvement program shall also be identified and notified in writing to the ATS SCM for approval.

All items supplied for CSA N285.0 or CSA B51 projects shall be supplied in accordance with Code Requirements. Additional, PO requirements shall be supplied by the respective division and contractually flowed down to the supplier.

3.0 Quality System Evidence Requirements

Suppliers are responsible for developing and implementing effective operating systems to control and improve the quality of their process and products.

ATS requires all suppliers to have available, documented evidence to ensure compliance to contract and specified quality requirements upon request.

ATS, Regulatory Authorities or ATS customer's reserves the right to evaluate documented evidence at any point in time of the products life cycle.

4.0 Quality System Registration – Guidelines

The supplier shall have the appropriate quality system registration for the product, material, or services being supplied to ATS when flowed down as a requirement by contract.

The preferred supplier will have third party quality system registration to:

- ISO 9001 at a minimum or equivalent. Note: ATS contract provisions shall apply for divisions where Quality requirements exceed the basic requirements of ISO 9001 requirements (i.e. N286, N285, and N299). The applicable division shall implement the necessary controls required in order to manage the supplier contractually.

The supplier shall provide a copy of the quality system registration certificate to ATS Supply Chain, to retain on file. The supplier shall advise ATS, in writing, of any changes to their registration status; whether renewal, probation, revocation, upgrading or certification to additional standards.

ATS reserves the right to request further registration certificates, as appropriate, i.e., Medical, Laboratory, Environmental, etc. Such additional requests shall be dependent upon the end use of the product, material or services or ATS customer specified requirements.

5.0 Precedence of Documents (unless otherwise specified by Code)

In the event of apparent conflict, the following precedence shall prevail:

1. ATS deviation/waiver request
2. ATS purchase order
3. ATS engineering drawing

6.0 Written Deviations/ Waivers

Any waiver or change from the requirements of a purchase order shall not be valid and binding upon ATS unless in writing and signed by an authorized ATS representative. The supplier shall use this process when necessary and not as a method to accept defect product as an on-going practise.

The supplier is responsible for raising a Deviation/Waiver Request and forwarding to ATS for approval for the following circumstances:

- If an alteration to a part is required and deviates from the drawing requirements
- If the product does not meet specifications and cannot be reworked in time to meet delivery requirements.
- For any material equivalencies and/or alternatives part substitutions. The MTR/material specification must match the requirements on the drawing when specified. The supplier is not permitted to assume an alternative material will be acceptable.

If the request is approved, a signed copy will be returned to the Supplier. The Supplier shall attach a copy of the deviation request to the relevant shipment. *Reference DW form in appendix A.*

In the event that the supplier provides the same product, material or service to multiple ATS facilities, the supplier shall submit individual written waivers to each of the ATS facilities. Approval of a written waiver by one ATS facility does not constitute automatic approval by other ATS facilities.

7.0 Terms & Conditions

The supplier shall comply with all Terms and Conditions that accompany ATS purchase orders, releases, contracts or supply agreements unless otherwise agreed in writing.

8.0 Specifics

The supplier shall agree to price, quantity, delivery and payment conditions as specified on purchase orders, releases, contracts or supply agreements.

9.0 Productivity / Continuous Improvement

All Suppliers are expected to provide World Class Performance and Services with emphasis on Quality, Delivery and Price. Global Suppliers are measured continually with scorecards published quarterly reflecting individual supplier status. Objective will be a 100% Total Rating. Top performing Suppliers may be recognized with a status of “Preferred Supplier” or “Supplier of the Year”

10.0 Documentation Requirements

Special process procedures, Dimensional Reports, Material Traceability Records, C of C (Certificate of Compliance), First Article Inspection Reports Manufacturing, Inspection & Test Plans or any other required document(s) specified on the Purchase Order or Product Drawings are to be shipped with the product. *Reference Appendix B for examples*


Product that does not satisfy documentation requirement(s) will be subject to the ATS Non-Conforming Product procedure.

Documentation retained by the supplier and/or submitted to ATS practices shall meet the following requirements:

- a) Permanent: Information cannot be changed, erased or washed off. Whiteout and pencil is not permitted.
- b) All information included in the document is truthful to the knowledge and ability of the organization.
- c) Information can be easily read and legible. Errors are properly corrected (i.e. line strike), initialed and dated. Do not scrawl or black out with pen
- d) Document shall be detailed to ensure information is clear and concise to all audiences.
- e) Information such as dates, times and abbreviations, are consistent within the documents.
- f) All information is included and not missing information. Blank spaces shall be identified with NA.
- g) Contractual quality/project document requirements shall be provided in the primary language of the country purchasing the equipment/part unless otherwise specified by ATS. (I.e. North America – English).

11.0 Key Characteristics

Key Characteristics are product requirements that could potentially have a significant effect on safety, fit, function and compliance with (applicable) regulations or the ability to further process or build the product.

Characteristics on drawings identified with a  symbol, unique tolerance outside of the title block or GDT feature require a dimensional report to be kept on file by the supplier and/or provided with the parts as stipulated in the Purchase Order Agreement.

For a quantity of parts greater than 1, the following table defines the minimum number of parts that are required to have a dimensional report provided:

Sample Inspection Plan Table: Reject on 1 and perform 100% sort

Lot Size	First Off Sample Size	In Process Sample Size	Last Off Sample Size
1	1	0	0
2	1	0	1
3 to 8	1	1	1
9 to 15	1	3	1
16 to 25	1	6	1
26 to 50	1	8	1
51 to 90	1	11	1
91 to 150	1	18	1
151 to 280	1	30	1
281 to 500	1	48	1
501 to 1200	1	78	1
1201 to 3200	1	123	1

Note: Exceptions to sample size must be submitted to ATS Quality for approval.

12.0 First Article Inspection (FAI)

As required by contract, the supplier shall submit a first piece sample(s) for review, verification and approval by ATS including a First Article Inspection Report that demonstrates compliance with the requirements of the PO and associated reference documents.

The Supplier shall produce the sample(s) from the associated production tooling only. The supplier is not permitted to send any prototype samples unless otherwise approved by ATS. A minimum of one piece produced from each tool, fixture, cavity or impression shall be submitted to ATS unless otherwise specified by contract.

NOTE:

The supplier is responsible for contacting the ATS supply chain representative to determine the appropriate FAI template that is required for submission.

Sample submissions shall not waive the supplier's obligation to fulfill the delivery requirements in conformance with applicable drawings and specifications.

Changes to drawing/specification revisions, process tooling, manufacturing location or equipment alteration beyond normal maintenance will require the supplier to resubmit of a first piece sample.

The supplier shall notate all products submitted as a first piece sample either on the shipping document, container or bag.

13.0 Manufacturing, Inspection and Test Plans (MITP)

The supplier shall be responsible for creating and submitting a MITP or ITP when stipulated contractually by ATS. The supplier shall plan and identify characteristics to be inspected, examined and tested at each point within the Supplier's process. These plans shall be submitted for approval based on the contract requirements stipulated by ATS. ATS shall identify any required witness and hold points beyond which the work shall not proceed. Independent

inspection shall also be instituted when identified by contract. The supplier is accountable to ensure these requirements are understood and enforced within the facility. Failure to comply with these requirements may result in a temporary or permanent suspension.

14.0 Special Quality Code Requirements – if stipulated on the ATS Purchase Order

Required QA Program Level	Equivalent QA Program: ISO 9001:2015 plus additional clauses indicated by*						
	F.3 Design Verification	B.4.1 Receiving Inspection	C.4 Inspection and Testing	C.5 Inspection and Testing	B.2 Supplier Evaluation and Qualification [Note 3]	B.5 Storage and Handling	3.5.14 Special processes [Note 2]
CSA N299.2	*	*	*		*	*	Covered by standard
CSA N299.3		*	*		*	*	Covered by standard
CSA N299.4				*			*

Notes:

1. Additional clauses taken from CSA N286-05 with guidance from Appendix G.
2. Additional clause taken from CSA N299.3-85 and applicable if the supplier is responsible for special processes and approved to a CSA N299.4-85 level. (Note 1). The supplier is responsible for incorporating these additional requirements into their existing program.
3. Clause B.2 is only applicable if the supplier is permitted to subcontract work.

F.3 Design Verification

Verification shall be performed at various stages of the design to confirm that the design will meet the user's requirements. Typically, verification is applied at the following stages of design:

- a) During selection of design inputs
- b) During preparation and selection of the conceptual design
- c) During the detailed design; and
- d) Prior to the issuance of design documents

One or more of the following verification techniques shall be used in the design process:

- a) Independent review of design deliverables by one or more qualified designer(s) who did not participate in the design;
- b) Multidisciplinary design review teams;
- c) Alternative analysis to check the validity of design calculations. Such analyses can employ simplified calculations and assumptions that can yield approximate results; and
- d) Qualification testing of a prototype or initial production unit to verify the design or specific design features.

B.4.1 Receiving Inspection

Visual examination shall be performed and documented to establish that

- a) The item received is free from physical damage;
- b) The specified packaging and shipping requirements have been maintained during shipping;

- c) Identification and markings are in accordance with applicable codes, specifications, purchase orders, and drawings; and
- d) Protective covers and seals, coating and preservatives, inert gas blankets, desiccants, etc., are performing as intended.

In addition to the visual examination, there shall be evidence that

- a) The item received was fabricated, tested, and inspected prior to shipment, in accordance with the applicable code, specification, purchase order, or drawings;
- b) The documentation requirements of the purchase order for the item have been met; and
- c) The documentation has been reviewed by an organization other than the issuer of the documentation to ensure that the technical requirements of the item have been met.

If the item requiring inspection was not inspected at the source, the item shall be inspected at the point of receiving to verify conformance with purchase order requirements.

C.4 Inspection and Testing

The supplier shall prepare an Inspection & Test Plan which describes the inspections, tests and verification methods for the product or service specified in the contract. The plan shall be approved by the organization primarily responsible for quality. Unless otherwise specified by contract, the supplier shall:

- a) Submit the plan to ATS for acceptance following the award of the contract before initiating any activities related to the purchased product or service.
- b) Update the plan during the life of the contract to reflect any necessary revisions and resubmit for acceptance.
- c) Applicable inspection and test procedures shall be submitted to ATS upon request.

Independent Inspection and tests shall be carried out in accordance with approved procedures/Inspection & Test Plans. The Inspection & Test Plan shall include:

- a) Identification of the inspection/test procedures that specify the inspection or test requirements;
- b) Identification of the characteristics to be inspected or tested;
- c) Acceptance criteria;
- d) A description of the method of inspection or test, including the equipment to be used (including any measuring and monitoring devices) and the conditions that must be controlled; and
- e) Identification of the qualifications required for the individuals or groups responsible for performing the inspection or test.

Measures shall be established and documented to identify inspection and test status. Such measures shall ensure that required inspections and tests are performed and that the acceptability of items is known throughout construction and installation. Work shall not be permitted to proceed beyond a hold point until the verification activity is performed.

Inspection and test status shall be documented using indicators such as stamps, tags, labels, routing cards, inspection records, or other suitable means. Appropriate measures shall provide for the identification of those items which conform to inspection and test requirements and those which do not.

Independent Inspection – Personnel assigned to perform acceptance, final inspection, monitoring or witnessing activities shall be other than those performing or directly supervising the work unless otherwise approved by the ATS Quality and documented in the Inspection & Test Plan.

C.5 Inspection and Testing

Independent Inspection – Personnel assigned to perform acceptance, final inspection, monitoring or witnessing activities shall be other than those performing or directly supervising the work unless otherwise approved by ATS Quality through the Deviation Waiver Process.

The supplier shall:

- a) Plan inspection and test activities
- b) Inspect and test the product or service as planned
- c) Prepare a checklist of characteristics of the product or service to be inspected and tested when specified by contract.

B.2 Supplier Evaluation and Qualification

The selection of a supplier shall be based, in part, on an evaluation of the supplier's ability to deliver a technically acceptable product or service. The evaluation shall confirm that the products or services meet technical requirements, including safety, reliability, and maintainability. The vendor's management system and supply history shall also be evaluated. The supplier's technical documents submitted for approval shall be reviewed and accepted by qualified technical personnel.

Audits shall be planned and performed to confirm that supplier management systems have been implemented and are effective.

Audits shall be carried out with sufficient frequency to confirm that the supplier's management system remains effective. Scheduled audits shall be supplemented with additional audits when the effectiveness of a management system is in doubt. Audit scope and timing shall take into consideration the maturity of a management system.

When the audit portion of the purchasing management system is delegated, the responsible organization shall ensure that the results of the supplier's audits are acceptable.

Audits to qualify suppliers shall focus primarily on the manufacturer, but shall also take into account those organizations, such as agents and distributors, that are involved in the procurement transaction. For example, the following activities may be performed by agents, distributors, and others who are not the manufacturer: marking of the items, handling and storage, documentation control, assembling and/or creating records, preservation and packaging, and inspection and verification.

B.5 Storage and Handling

Measures for the control of storage and handling shall preserve items from the time of their receipt and prevent their damage, deterioration, or loss.

Inspections shall be performed periodically and the results documented to ensure that storage areas and items are being maintained as required.

For items that require special handling or special tooling and equipment, appropriate instructions shall be prepared and implemented.

When special handling tools and equipment are required, they shall be inspected and tested at specified times to verify that they are adequately maintained.

3.5.14 Special Processes

3.5.14.1

A special production process is a production process where conformance is assured by using evidence generated during the process. A production process is a special process when subsequent inspections required to establish conformance are either impossible or undesirable.

3.5.14.2

A special inspection process is an inspection requiring either specialized inspector skills or inspection techniques, or both.

3.5.14.3

- A) Identify production and inspection special processes
- B) Ensure that these processes are accomplished under controlled conditions by qualified personnel using qualified process procedures, documentation and equipment according to specified requirements and established criteria.
- C) Maintain qualification records for qualified personnel, process procedures, documentation and equipment according to the requirements of applicable codes and standards.
- D) Define the necessary qualifications of personnel, process procedures, documentation and equipment for special processes not covered by existing codes or standards or where product or service quality requirements exceed the requirements of established codes or standards.
- E) Maintain evidence generated during the process which indicates that control of the process has been achieved.

15.0 Supplier Performance System

Total Rating of 100% is comprised of 40% Delivery, and 60% Quality.

- **On Time Delivery (40% of Total Rating)**

The supplier shall strive to meet the goal of 100 % on time delivery. The delivery date is defined on the Purchase Order or Blanket Purchase Order release and is compared to the Receive date at ATS.

- **Quality (60% of Total Rating):**

- **Administrative and Documentation Compliance – 20%**

These measurements include missing certifications, missing dates, documentation errors, incorrect part numbers, revisions and labeling, excessive/ unauthorized premium freight and incorrect shipping methods.

- **PPM - Parts per Million – 20%**

The supplier shall strive to meet the goal of zero defects. Defective product received by ATS will be monitored using parts per million (PPM).

- **Supplier Corrective Action Request (SCAR) Response Time – 15%**

Corrective action response times are: Containment = 24 hours and total completion 10 calendar days. All unaccepted corrective actions will be treated as late response.

Quality Standard Certification – 5%

ATS requires the latest 3rd party registration certificate on file at ATS (AS9100, ISO, TS, etc.).

At least yearly, selected Global Suppliers will receive a scorecard as per the above criteria. The supplier shall be responsible for taking action by submitting recovery plans if the Global Supplier scoring falls below 73%.

All other suppliers will be sent a scorecard at the discretion of Supply Chain Management and / or Quality.

The supplier will be responsible for submitting an action plan to improve their performance to ATS Supply Chain Management and Quality. Any supplier will be subject to removal from the ATS Approved Supplier List if that supplier does not respond or continues to have performance issues that are deemed unacceptable by ATS.

16.0 Accessibility to Facilities

ATS shall have rights of access to the Supplier's and any sub tier supplier's facilities and records for inspection or audit by ATS, our designated representative our customer and the regulatory authority. This shall include, but is not limited to, the right to audit material, test, inspection, services, and quality records; conduct surveillance visits during manufacturing; and witness tests to the extent ATS deems necessary to assure that work is being performed in accordance with all product design and manufacturing requirements.

This requirement shall be extended to contracted agents or customers of ATS.

17.0 Verification at Source

ATS personnel shall perform source verification at the supplier's premises prior to shipment when specified as a requirement on the Purchase Order or within the Inspection & Test Plan. The supplier is responsible for notifying the ATS Supply Chain Representative in time for adequate scheduling of personnel.

18.0 Quality Planning

The supplier shall have resources available and be capable of participating in quality planning and product launch efforts. The supplier shall be able to provide the following documents when required (The AIAG documents can be used for guidance where applicable):

- Process flow diagram
- Process Failure Mode and Effects Analysis (PFMEA)
- Control Plan

When the supplier is providing product, material or services which have an automotive application, the following Automotive Industry Action Group (AIAG) documents and formats are considered to be applicable extensions of this Supplier Manual and ATS requirements:

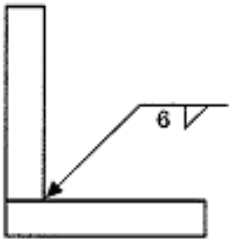
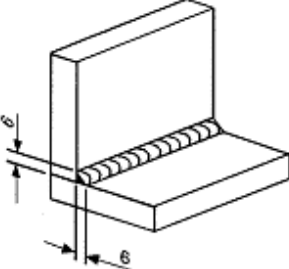
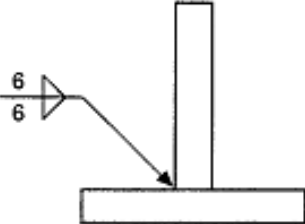
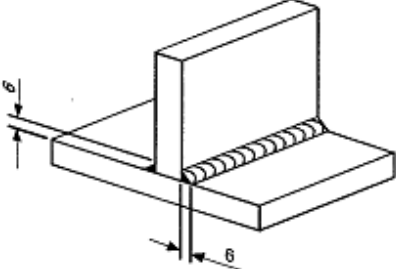
- PPAP – Production Part Approval Process
- APQP – Advanced Product Quality Planning
- FMEA – Failure Mode and Effects Analysis
- MSA – Measurement Systems Analysis
- SPC – Fundamentals of Statistical Process Control

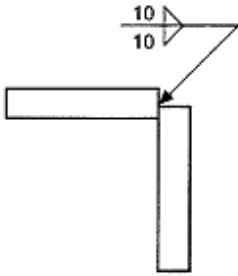
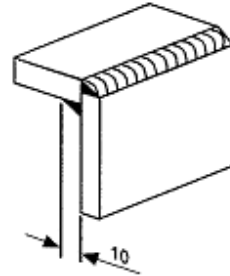
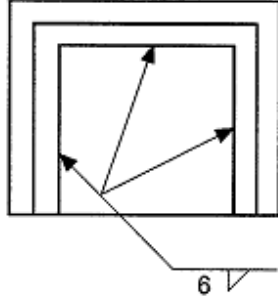
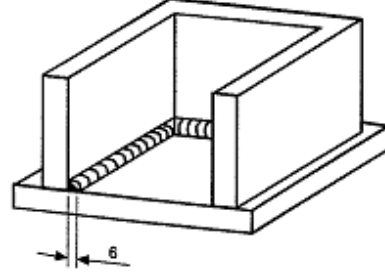
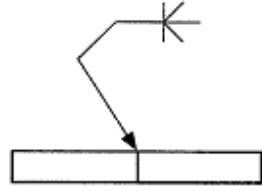
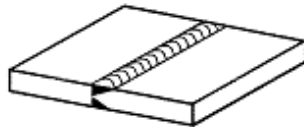
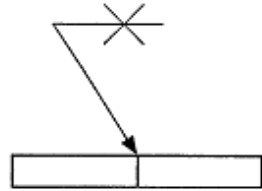
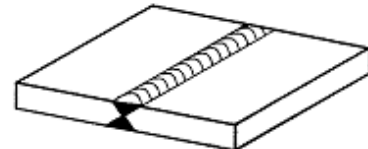
Suppliers are responsible for obtaining and maintaining current editions of these documents as required by contract. For information on obtaining these documents visit: www.aiag.org.

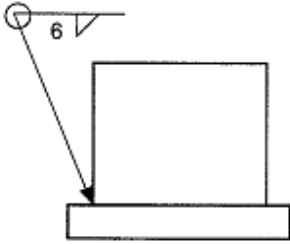
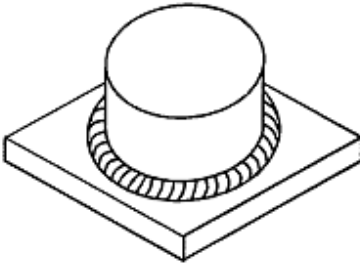
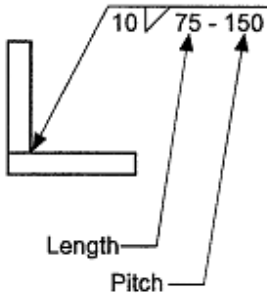
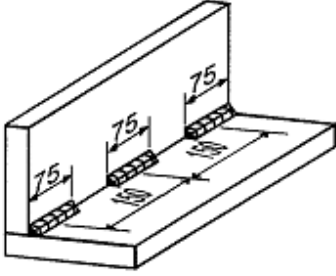
19.0 Welding Certification & Acceptance Criteria

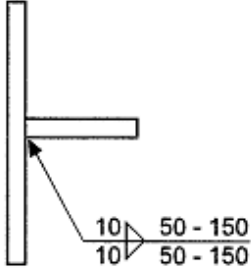
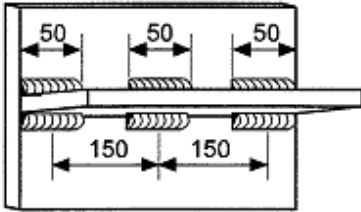
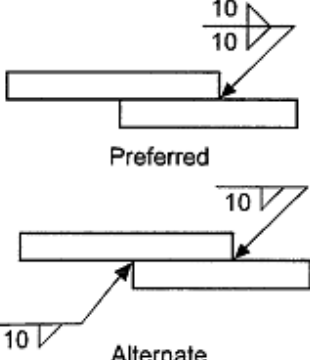
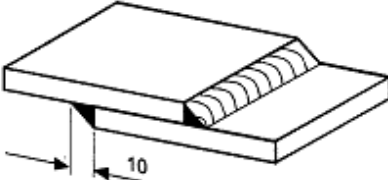
All Canadian welding sub-contractors to ATS may be required to hold a current CWB certification to CSA W-47.1 and/or W-47.2 (latest published edition), CSA N285 or CSA B51 C of A as applicable. Each division shall contractually specify requirements on the Purchase Order as required.

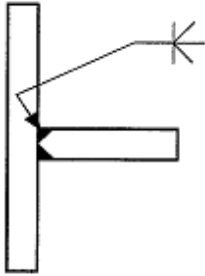
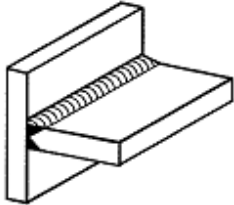
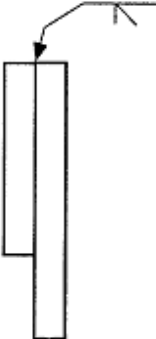
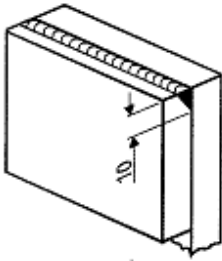
The following general Weld Workmanship requirements apply unless otherwise specified by contract:

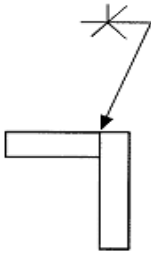
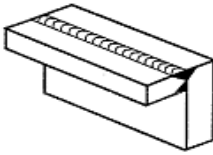
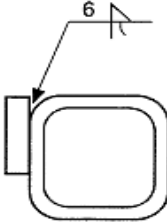
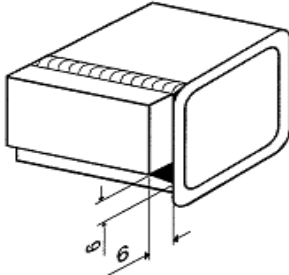
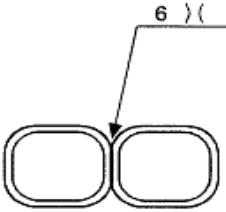
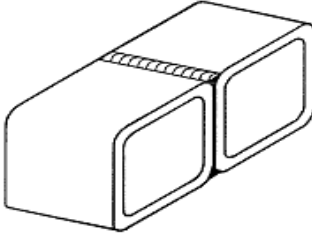
Drawing Symbol	Desired Weld	Remarks
	 <p style="text-align: center;">SINGLE FILLET</p>	<p>Common Fillet Weld – Requires no special edge preparation.</p>
	 <p style="text-align: center;">EQUAL DOUBLE FILLET</p>	<p>When both fillets are same size, only one size specification is provided. Primarily used for steels.</p>

Drawing Symbol	Desired Weld	Remarks
	 <p>DOUBLE FILLET CORNER</p>	Applicable to steels and aluminums. Outside fillet assumed to cover exposed edges of the plates.
	 <p>FILLET, ABRUPT CHANGE IN DIRECTION</p>	Continuous weld through abrupt changes of direction. An arrow points to each significant surface where a weld is required.
	 <p>DOUBLE BEVEL BUTT</p>	Arrow points to the beveled part. Symbol as shown assumes 100% penetration for metals 19.05mm (.75") thick or less. On thicker butt welds, penetration is 9.52mm (.38") from each side.
	 <p>DOUBLE V BUTT</p>	Normally used only to butt weld aluminum. Symbol indicates 100% penetration for metals 19.05mm (.75") thick or less. Penetration of 9.52mm (.38") is used for thicknesses greater than 19.05 (.75").

Drawing Symbol	Desired Weld	Remarks
	 WELD, ALL AROUND	<p>A circle at the break in the dimension line indicates that the weld is continuous.</p>
	 INTERMITTENT WELDING	<p>First number after the symbol indicates the length of the weld. Second number indicates the pitch length between welds.</p> <p>This weld is used only for long sections where sanitation is not a concern. Welds must be located at both ends of the joint.</p>

Drawing Symbol	Desired Weld	Remarks
	 CHAIN INTERMITTENT	<p>Same principle as preceding example.</p>
	 DOUBLE FILLET - LAP JOINT	

Drawing Symbol	Desired Weld	Remarks
	 <p data-bbox="760 470 976 499">DOUBLE BEVEL TEE</p>	<p data-bbox="1127 239 1417 506">Preferred method for welding aluminum. This method is used on steel only when clearance requirements prevent fillet welding. All butt welds require 100% penetration on materials 19.05mm (.75") thick or less.</p>
	 <p data-bbox="748 842 992 871">SINGLE BEVEL EDGE</p>	<p data-bbox="1127 632 1382 772">Normal method for welding pads onto large frames where only the edge of the pad can be beveled.</p>

Drawing Symbol	Desired Weld	Remarks
	 DOUBLE BEVEL CORNER	Symbol shows single V notching of outside and single bevel notch of inside corner for penetration. Commonly used on aluminum but also used on steels when clearance or machining requirements dictate.
	 FLARED V GROOVE AND FILLET	Used primarily in frame and cross brace applications. (Naturally occurring weld pockets as shown eliminate joint preparation.)
	 FLARED V GROOVE	

20.0 Managing Change

The supplier is required to notify ATS early enough in the process for any:

1. Change in ownership, location, or significant management change(s)
2. Change in raw material
3. Change in technology, if applicable

Note: A process / product change or substitution by a sub-tier supplier would constitute a change requiring notification to ATS.

Inform the ATS Supply Chain Representative for approval prior to proceeding with production and / or shipment of affected product. **Reference section 6.0 Written Deviations/Waivers for specific requirements.**

21.0 ATS Incoming Inspection

Suppliers are responsible for providing product that meets or exceeds expectations of the purchase order. ATS may inspect parts to confirm supplier quality and request additional information from the supplier.

22.0 NDE Testing

All non-destructive examinations are performed in accordance to ASME applicable requirements and by personnel qualified to at least CGSB Level II or SNT-TC-1A or as specified by contract.

23.0 Gauging & Calibration

For the purposes of clarification, the term gauging refers to fixtures, inspection, measuring and test equipment, as well as regular hand held gauging. This requirement applies to employee owned gauges, as well as company owned gauges and customer supplied gauges.

Suppliers shall have appropriate gauging available to conduct regular routine measurements of quality characteristics. Gauging shall be of the required precision and accuracy to properly evaluate the conformance of the product. All gauging shall be identified with a status indicator of the calibration.

The supplier shall have a documented system in place to calibrate all gauging at determined intervals appropriate to the usage of the gauging. Calibration shall be traceable to an international or national standard. Calibration records are subject to review by ATS.

Suppliers providing product to CSA Z299 QA requirements shall ensure the method for calibration shall be based on the manufacture's specification or the procedures approved for use through a valid ISO 17025 accreditation. The supplier shall issue a calibration certificate traceable to The National Research Council of Canada (NRC), and/or The National Institute of Standards and Technology (NIST), with the following information: calibration identification number, Calibration date, Pass / Fail status, before and after results, reference to calibration procedure utilized.

24.0 Delivery of Materials or Products with a Limited or Specified Shelf Life

The Supplier shall ensure that materials or items with a limited expiration date or shelf life shall be a minimum of 75% of the total shelf life upon receipt of order.

These items shall have the expiration date identified either on the individual container and/or with the documents provided with the order.

Examples of shelf life material include but not limited to: gaskets, epoxies, paints, adhesives, sealants, hardware locking compounds.

25.0 Hazardous Material & Material Safety Data Sheets (MSDS)

All product, material or services provided to ATS shall satisfy current governmental regulations applicable to the country of sale as well as the country of manufacture. Governmental regulations typically may include, but are not restricted to:

- Environmental impact
- Toxic & hazardous materials
- Electrical codes
- Electromagnetic outputs
- Banned and Regulated Substances (International **M**aterial **D**ata **S**ystem IMDS)

Material Safety Data Sheets (MSDS) must be submitted to the applicable ATS facility receiving the product material or service.

If MSDS information is not submitted, or approval is not obtained, the PPAP submission (if applicable) may not be approved, or subsequent shipments rejected. In the event that the supplier provides the same product, material or service to multiple ATS facilities, the supplier shall submit individual MSDS information to each of the ATS facilities. Approval of an MSDS submission by one ATS facility does not constitute automatic approval by other ATS facilities.

26.0 RoHS/WEEE/REACH

All suppliers acknowledge that all material, items, components and sub components are fully compliant with RoHS (Restriction of Hazardous Substances), WEEE (Waste from Electrical & Electronic Equipment & Recyclability) and REACH (Registration, Evaluation, Authorization & Restriction of Chemicals). Suppliers shall maintain documented evidence of compliance for submission to ATS upon request.

Current legislation (such as the EU ELV Directive 2000/53/EC for end-of-life vehicles and the EU WEEE Directive 2002/96/EC for waste electrical and electronic equipment) has targeted the elimination of heavy metals (lead, cadmium, mercury, hexavalent chromium and their compounds), carcinogenic, mutagenic, and/or toxic chemicals, with the aim of increasing the recyclability of commercial products.

Suppliers are encouraged to familiarize themselves with this requirement and future customer compliance Ref: www.mdsystem.com. The IMDS account number for ATS PCG 9429.

27.0 Conflict Minerals

Suppliers shall to take appropriate steps to determine if their products contain conflict minerals (tin, tantalum, gold, and tungsten) and if so, implement supply chain due diligence processes to identify sources of these minerals and support efforts to eradicate the use of conflict minerals which directly or indirectly finance or benefit armed groups in the Democratic Republic of Congo or adjoining countries

28.0 Material and Process Specifications

ATS may use one or more specifications for any product, material or service. Specifications may be referenced on Purchase Orders, Engineering drawings, attachments, or supply agreements. In the absence of plating specifications (as stated above) the supplier shall default to Appendix C requirements. Material equivalencies have been identified in Appendix D if specific requirements have not been identified on the drawing. **Note – Material utilized for Nuclear applications are not permitted to substitute material as per Appendix D without ATS approval prior to Manufacturing.**

The supplier shall be responsible for obtaining and maintaining the current revision of specifications referenced. The supplier shall be responsible for compliance to all specifications detailed. The supplier shall notify ATS of any requirement for exception, deviation or waiver. Any such notification must be documented to ATS for approval. Reference section 6.0 Written Deviation/Waivers for further requirements.

For any product, material or service, which requires the supplier to subcontract to external facilities, the supplier shall be responsible for ensuring compliance to specifications. The ATS supplier shall be considered responsible for all aspects of subcontractor performance.

Proposed changes to specifications will be sent to suppliers for review and acknowledgement. It is the supplier's responsibility to review proposed changes and respond, in writing concurrence as written or requesting exceptions, deviations or waivers. Upon agreement of the proposed changes between ATS and the supplier, production shipments incorporating the change cannot begin until approval is obtained {see Managing Change}. Suppliers are responsible for supplying products that meet the current revision level of all specifications.

29.0 Workmanship

There are quality expectations associated with any product, material or service supplied to ATS, which are intrinsic or understood to apply. Such expectations are derived from industry benchmarks and may not necessarily be detailed on the prints provided to the supplier. Examples of poor workmanship may include, but are not restricted to:

- Mixed parts / foreign objects
- Rust / Contamination / Dirt
- Discoloration / stains
- Burrs / Scratches / Sharp edges
- Flakes / slivers
- Flash
- Excessive oil / wash residue

In the event, ATS considers the workmanship to be substandard, the material product or service shall be treated as Non-conforming Product.

30.0 Workmanship – Paint

Painting shall be completed using SSPC-PA1 for guidance (excluding roller requirements) unless otherwise specified by contract.

The following defects will not be accepted by ATS:

- **Run or Sag:**

Fluid coating which runs down the side of the part. Leading edge has a thick nodule

- **Dry Spray (over spray):**

Characterized by surface roughness and loss of gloss in dry spray area. Caused from paint going directly to part but was not fluid enough to form a smooth film

- **Orange Peel:**

Similar appearance to an orange peel and is a textured finish that appears to have small depressions. Caused when paint droplets are not fluid enough to flow together smoothly.

- **Blistering:**

Small spots under the film that gradually enlarges until it can be felt as well as seen. Usually caused by contamination (salt, oil, etc.) under the paint.

- **Fish Eyes:**

Small depressions found in the paint. Vary in size up to 0.25" or more. Have a darker raised center and an 'outside-ring' appearing as a crater. Often caused by contaminants such as oils, grease, silicon lubricants, etc.

Popping, Bubbling, Pin-holing:

Popping may appear as a bubble that has burst, leaving a jagged edge. Pin-holing may be a void in the film that goes right to the part surface, appearing as hole caused by a sharp object. They are caused by a rapid loss of solvent from a wet paint film.

- **Contamination:**

Visible dirt or debris found within the paint or excessive weld splatter.

31.0 Knurling

Knurling shall be in accordance with ANSI/ASME B94.6 latest available edition unless otherwise specified by contract.

32.0 Corrective Action

Suppliers performing below expectations will be sent an ATS SCAR for completion (Supplier Corrective Action Request). Other formats may be requested in order to satisfy ATS customer requirements.

Upon receipt of a SCAR the supplier shall submit a containment response, when requested, within one business day. Every effort should be made to expedite the closure of the supplier corrective action report, in order to prevent recurrence. The supplier shall notify ATS of updates to the supplier corrective action report, as it develops toward closure. Completion of the entire supplier corrective action report is due in 10 working days from the date it was received. If an investigation extends beyond the due date a request for extension must be made to the Supply Chain and or Quality representative for the division.

33.0 Traceability

Suppliers shall establish a documented system, which provides for positive identification and record keeping for each lot throughout the production process per shift, from receipt through to delivery.

34.0 Record Retention

At a minimum, suppliers shall maintain quality records for 5 years, or the life of the product plus one additional year (as required by ATS Purchase Order Agreement), whichever is greater. Records shall be maintained in accordance with Code for CSA B51 & CSA N285 projects.

Records to be maintained include:

- Material certifications / Certificates of compliance / Inspection Records
- Customer reference documents (prints, specifications, etc.)
- Contract Review (offers, documents established in negotiating and implementing contracts)
- Customer Purchase orders and amendments
- APQP documentation including PPAP submissions with supporting documentation and parts
- Manufacturing, Inspection and Test Plans
- Tooling Management records
- Calibration records and Gage R&R's

- Nonconformance Reports, Concessions, Deviations or waivers issued by ATS
- Process Instructions and/or Process Sheets/Travelers/Inspection records

ATS reserves the right to stipulate retention requirements greater than 5 years as required by contract.

35.0 Shipping & Packaging Requirements

All products supplied to ATS facilities must be in suitable packaging to avoid damage to goods when shipped. All suppliers are encouraged to refer to the ATS Guidelines for Packaging and Transportation of Materials, available upon request from an ATS Supply Chain Representative.

Appendix A

Note: Sample only – request form from ATS Supply Chain Representative or download from:

<http://www.atsautomation.com/en/About%20Us/Supplier%20Quality%20Management/Supplier%20Deviation%20Waiver%20Process.aspx>

Automation Tooling Systems		REQUEST FOR DEVIATION/WAIVER		
1. Required Entry (to be entered by requester)				
TYPE OF DEVIATION 1. <input type="checkbox"/> SUPPLIER MATERIAL <input type="checkbox"/> ATSCUSTOMER		DEVIATION/WAIVER NUMBER		DATE OF DEVIATION ISSUED
1. SUPPLIER OR CUSTOMER FULL NAME AND ADDRESS		1. ATS PURCHASE ORDER NUMBER		1. QUANTITY ORDERED ON THIS PURCHASE ORDER
		1. ATS PART NUMBER		1. QUANTITY SUBMITTED ON THIS DEVIATION
1. ATS BUYER'S NAME (REF PURCHASE ORDER)		1. ATS PART NAME		1. PROJECT NUMBER (INTERNAL)

ITEM NO	FILE NAME OF MARKED UP ATTACHMENT	1. DISCREPANCY		1. QUANTITY	DISPOSITION		
		1. DWG OR SPECIFICATION REQUIREMENT	1. ACTUAL READING		ACCEPT AS IS	REPAIR	SCRAP

COMMENTS

1. ROOT CAUSE OF DISCREPANCIES

NOTE: ROOT CAUSE TO BE IDENTIFIED FOR EACH DISCREPANCY

1. COMPANY REPRESENTATIVE (Suppliers as applicable)

1. DATE

ATS & Customer use only

SUPPLIER/CUSTOMER MATERIAL REVIEW BOARD – AUTHORIZATION TO PROCEED						
Check if required	Name:	Signature:	Date:	Approved	Rejected	
<input type="checkbox"/> CUSTOMER APPROVAL				<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/> ATS ENGINEERING REPRESENTATIVE				<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/> ATS PM REPRESENTATIVE				<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/> ATS SUPPLY CHAIN REPRESENTATIVE				<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/> ATS QUALITY REPRESENTATIVE				<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/> ATS MANUFACTURING REPRESENTATIVE				<input type="checkbox"/>	<input type="checkbox"/>	
Comments						

Approved copy to be forwarded to ATS Quality

Appendix B:

This section indicates guidance on the requirements for the following documents:

Certificate of Compliance

1. Must be on Certifying company Letterhead
2. Traceability to the ATS PO and or Part number / revision
3. Identify the certification to stated standard or requirement (i.e. We certify that this product processed per "Plating Spec XXX, Passivated per Spec XXX Heat treated per Spec XXX, Electro Polish per Spec XXX) etc. as outlined on the ATS PO or Drawing.
4. Quantity
5. Dated
6. Signed by Quality Authority as outlined
7. Exceptions clearly stated of any deviations (Must be ATS approved through Deviation with Deviation # noted)

Heat Treatment – in addition

1. For each heat treatment cycle - the actual temperature range & duration (hrs.) of each heat treat cycle.

Material Traceability Record

With each lot of raw material delivered or used to fabricate products the supplier shall furnish a "Material Test Report" MTR. When more than one heat/lot of raw material is delivered at the same time, each heat/lot of material must be identified to provide traceability to its certification/material test report.

Each MTR shall include:

1. Name of the company that furnished the material
2. Material description name or designation, including as applicable, size or weight, alloy, type, class, grade or condition.
3. Lot, batch or heat number
4. Applicable specification and revision to which the material complies.

Each MTR furnished shall state the following:

"This is to certify that all (material) (products) delivered on this contract (number), (complies with) (were fabricated from material) represented by the attached Certifications/Material Test Reports"

Company Name: _____

Address: _____

Printed Name of Authorized Individual: _____ Date _____

Title: _____ Signature/Stamp: _____

Inspection record

The Supplier's inspection data shall show:

1. The part number/revision.
2. The actual values obtained during inspection versus the requirements of the drawing (including block data and notes) or specification.
3. When applicable, copies of material and/or process certifications shall be attached to the inspection report.

Appendix B: Example of a Certificate of Compliance Template:

Certificate of

Certificate of

Compliance

Customer:

Purchase Order/Contract #:

Supplier Name:

Item #	Description, Part Number & Revision	Serial Number/ Tool Number	Quantity

I hereby certify that the identified goods, supplied by “Supplier name”, comply with the requirements of the purchase contract unless otherwise identified below.

Comments/Exceptions:

Signed:

Date:

<Company Rep>, <Title>

Appendix B: Material Traceability Record Example

CERTIFICATE OF TEST CERTIFICAT D'ESSAIS

Page 01 of

Certification Date
12-JUN-2009

CUSTOMER ORDER NUMBER
NUMÉRO DE COMMANDE DU CLIENT

Invoice Number
S510601

1104
PART NUMBER/NUMÉRO DE PIÈCE

SOLD TO:
VENDU À:

SHIP TO:
EXPÉDIÉ À:

Description: 6061-T6511 EXTRUDED BAR AMS QQA 200/8, QQA 20
2 X 8 RECT X 12' R/L Line Total: 227 LB
HEAT: 11339189 ITEM: 513784

Specifications:
QQ A 200/8 ASTM B221 06 AMS-QQ-A-200/8
ASME SB221 99 UNS #A96061

ALUMINIUM CHEMICAL ANALYSIS

DESCRIPTION:

	SI	FE	CU	MN	MG	CR	ZN	TI
MIN	0.4		0.15		0.8	0.04		
MAX	0.8	0.7	0.4	0.15	1.2	0.35	0.25	0.15

OTHERS : EACH TOTAL
0.05 0.15 AL REMAINDER

RCPT: R662814
MILL :

COUNTRY OF ORIGIN :

MECHANICAL PROPERTIES

DESCRIPTION	YLD STR KSI	ULT TEN KSI	%ELONG IN 02 IN	%RED IN AREA	HARDNESS
	44.1	48.6	12.0		

MATERIAL IS FREE FROM MERCURY CONTAMINATION

COMMENTS

MADE IN THE USA

PRODUCTS MANUFACTURED WITH A T6511 TEMPER ALSO MEET T6 TEMPER

Appendix B: Dimensional Report Template unless otherwise stipulated by contract (page 1 of 2). Templates available at:

<http://www.atsautomation.com/en/About%20Us/Supplier%20Quality%20Management/Supplier%20Resource%20Library.aspx>



QUALITY INSPECTION REPORT

Project No.				Material				Lot size				
DWG No.				Humidity				QTY inspected				
Revision				Temperature				Inspected by				
P.O No.				Finishing				Date				
MTR #				Supplier				NCR Number				
<i>Note: CMM measurements will not be reocrd on this form.</i>												
No	Item	Standard Dimension	Tolerance	Sample 1		Sample 2		Sample 3		Status (AC/REJ)	Method	Method
				Actual	Dev	Actual	Dev	Actual	Dev			
1												
2												
3												
4												
5												
6												



QUALITY INSPECTION REPORT

Surface Ra meet print	<input type="checkbox"/> Accept	<input type="checkbox"/> Reject	<input type="checkbox"/> N/A
Even Plating finishing and COC Provided	<input type="checkbox"/> YES	<input type="checkbox"/> NO	<input type="checkbox"/> N/A
Hardness Test Results COC Provided	<input type="checkbox"/> YES	<input type="checkbox"/> NO	<input type="checkbox"/> N/A
Material MTR/COC Provided	<input type="checkbox"/> YES	<input type="checkbox"/> NO	<input type="checkbox"/> N/A
Deburring and Appearance Check	<input type="checkbox"/> YES	<input type="checkbox"/> Reject	<input type="checkbox"/> N/A

Method	Gauge Number
Code	Equipment
CMM	CMM
PP	Profile Projector
MC	Micrometer
PG	Pin Gauge
BG	Block Gauge
IC	Vernier
HG	Height Gauge
RG	Radius Gauge
QS	Quickscope
HT	Hardness Tester
PM	Profilometer
IN	Indicators

Finishing	
Code	Type
BA	Black Anodized
CA	Clear Anodized
HC	Hard Clear
HCH	Hard Chrome
EP	Electrol Polish
H	Harden
FC	Flash Chrome
ZP	Zinc Plating
HB	High Black
N	Nickel
P	Passivate
MR	Mirror
OTHER	
OTHER	

Appendix C (Reference Section 27): Standards for Applying Surface Plating, Coatings and Treatments:

SURFACE PLATINGS				
PROCESS	SPECIFICATION FOLLOWED	THICKNESS	COMMENTS	COLOUR/FINISH
Clear Anodize	MIL-A-8625F TYPE 2, CLASS 1	.0003" [.007mm]	---	Light grey
Black Anodize	MIL-A-8625F TYPE 2, CLASS 2	.0004" [.010mm]	---	Black
Hard Anodize	MIL-A-8625F TYPE 3, CLASS 1	.0005-.0008" [.013-.020mm]	---	Dark grey
Hard Black Anodize	MIL-A-8625F TYPE 3, CLASS 2	.0005-.0008" [.013-.020mm]	---	Black
Hard Chrome	AMS 2406K	.0002-.0005" [.005-.0123mm]	---	Satin

Electro less Nickel	ASTM B733 TYPE 4, SC2, CLASS 1	.0004"-.0005" [.010-.013mm]	---	Gloss
Electrolytic Nickel (Nickel Flash)	ASTM B456 SC2B	.0005-.0010" [.013-.025mm]	---	Bright
Black Oxide	MIL-DTL-1392D	.0001-.0002" [.003-.005mm]	---	Black
SURFACE COATINGS				
PROCESS	SPECIFICATION FOLLOWED	THICKNESS	COMMENTS	COLOUR/FINISH
Painting Preparation	SSPC-SP1	N/A	Solvent Cleaning	---
Painting Preparation	SSPC-SP3	N/A	Power Tool Cleaning	---
Painting Preparation	SSPC-SP6	N/A	Commercial Blast Cleaning	---
Painting	SSPC-PA1	As per Manufacturer Data sheet	Exception to application of brush and roller – not permitted	---
			Powder coat =.002" min [.050 mm]	---
		As per Manufacturer Data sheet	Speed enamel = .002" [.050 mm]	---
		As per Manufacturer Data sheet	Epoxy = .004"-.008" [.100-.200 mm]	---
SURFACE TREATMENT				
PROCESS	SPECIFICATION FOLLOWED	THICKNESS	COMMENTS	COLOUR/FINISH
Passivation (440C SS)	AMS QQ-P-35C	N/A	---	Satin Grey
Passivation (300 Series SS)	ASTM A 967-99	N/A	---	Bright
Electro polishing (440C SS)	ASTM B 912-00	N/A	---	Satin Grey
Electro polishing (300C SS)	ASTM B 912-00	N/A	---	Bright
Pickling	ASTM 380	N/A	---	---

Appendix D (Reference Section 27): Material Equivalencies:

- Stainless Steel

ATS Material Stainless Steel					Chemical Composition Weight Percent										Grade	Mechanical Properties					Additional Notes
	Country	Standard	Standard Specification	Grade	C	Mn	P Max	S Max	Si	Cr	Ni	Mo	N	Fe		Hardness (Rockwell) max.	Ultimate Tensile Strength (Mpa)	Yield Strength (Mpa)	Percent Elongation	Impact Toughness (Joules)	
304	USA	AISI/ASTM A240	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications	304	0.08	2	0.045	0.03	1	18.0-20.0	8.0-10.5	...	0.1	Bal.	304	92 HRB	min. 517	min. 206	40	...	These USA based standards presented here are the typical properties for 304 stainless steels for plate, sheet, and strip. The ultimate tensile strengths and yield strengths may be higher for cold-worked materials. These USA standards are equivalent to the 304 standards for all of the countries presented here for 304.
		ASTM A666-15	Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar	304	0.08	2	0.045	0.03	0.7 5	18.0-20.0	8.0-10.5	...	0.1	Bal.	304	92 HRB	min. 517	min. 206	40	...	
		UNS	...	S30400	0.08	2	0.045	0.03	1	18.0-20.0	8.0-10.5	...	0.1	Bal.	S30400	92 HRB	min. 517	min. 206	40	...	
	Germany	DIN 17006	Designation Systems for Steel	1.4301	0.07	2	0.045	0.015	1	17.5-19.5	8.0-10.5	...	0.1 1	Bal.	1.4301	90 HRB		190-235	35	60 J	The differences between each of the German standards are based on the product form and whether the metal is plate or has been hot or cold-rolled. The strength of 304 stainless steel increases with cold work from the cold-rolling process and therefore the cold-rolled stainless steel typically exhibits on average higher tensile and yield strengths. These German standards are equivalent to the 304 standards for all of the countries presented here for 304. Hardness Values for EN 10088 are solution annealed
		DIN EN 10088-2:2005 Cold Rolled Strip	Stainless Steel Flat Products for General Purposes	X5 CrNi 18-10; 1.4301	0.07	2	0.045	0.015	1	17.5-19.5	8.0-10.5	...	0.1 1	Bal.	X5 CrNi 18-10; 1.4301	80 HRB (Solution Annealed)	540-750	230	45	...	
		DIN EN 10088-2:2005 Hot Rolled Strip	Stainless Steel Flat Products for General Purposes	X5 CrNi 18-10; 1.4301	0.07	2	0.045	0.015	1	17.5-19.5	8.0-10.5	...	0.1 1	Bal.	X5 CrNi 18-10; 1.4301	80 HRB (Solution Annealed)	520-720	210	45	100 J (Longitudinal), 60 J(Transverse)	
		DIN EN 10088-2:2005 Hot Rolled Plate	Stainless Steel Flat Products for General Purposes	X5 CrNi 18-10; 1.4301	0.07	2	0.045	0.015	1	17.5-19.5	8.0-10.5	...	0.1 1	Bal.	X5 CrNi 18-10; 1.4301	81 HRB (Solution Annealed)	520-720	210	45	100 J (Longitudinal), 60 J(Transverse)	
	Japan	JIS G4303: 2005	Japanese Standards Association for Specification for hot worked Stainless Steel Bars with different shapes.	SUS 304	0.08	2	0.045	0.03	1	18.0-20.0	8.0-10.5	Bal.	SUS 304	90 HRB	min. 520	min. 205	40	...	This Japanese standard for 304 stainless steel is equivalent to all of the countries presented here for 304.
	China	GB/T 4237-2015	Hot Rolled Stainless Steel Plate, Sheet, and Strip	S30408 / 06Cr19 Ni10	0.07	2	0.045	0.03	6	17.5-19.5	8.0-10.5	...	0.1	Bal.	S30408 / 06Cr19Ni10	92 HRB	min. 515	205	40	...	The Chinese standards are equivalent to one another with the only variations being due to the method of processing. These Chinese standards for 304 are equivalent to all of the other countries presented here.
		GB/T 3280-2015	Cold Rolled Stainless Steel Plate, Sheet, and Strip;	S30408 / 06Cr19 Ni10	0.07	2	0.045	0.03	0.7 5	17.5-19.5	8.0-10.5	...	0.1	Bal.	S30408 / 06Cr19Ni10	92 HRB	min. 515	205	40	...	
		GB/T20878-2007	Stainless and Heat Resisting Steels-Designation and Chemical Composition	S30408 / 06Cr19 Ni10	0.08	2	0.045	0.03	1	18.0-20.0	8.0-11	...	...	Bal.	S30408 / 06Cr19Ni10	...	...	...	...	...

ATS Material Stainless Steel					Chemical Composition Weight Percent											Mechanical Properties					Additional Notes
	Country	Standard	Standard Specification	Grade	C	Mn	P Max	S Max	Si	Cr	Ni	Mo	N	Fe		Hardness (Rockwell) max.	Ultimate Tensile Strength (Mpa)	Yield Strength (Mpa)	Percent Elongation	Impact Toughness (Joules)	
304L	USA	AISI/ASTM A240	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications	S30403	0.03	2	0.045	0.03	0.7 5	18.0-20.0	8.0-12.0	...	0.1	Bal.	S30403	92 HRB	min. 485	min. 170	40	...	These USA based standards presented here are the typical properties for 304L stainless steels for plate, sheet, and strip. The ultimate tensile strengths and yield strengths may be higher for cold-worked materials. These USA standards are equivalent to the 304L standards for all of the countries presented here for 304L.
		ASTM A666-15	Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar	S30403	0.03	2	0.045	0.03	0.7 5	18.0-20.0	8.0-12.0	...	0.1	Bal.	S30403	92 HRB	min. 485	min. 170	40	...	
	Germany	DIN 17006	Designation Systems for Steel	1.4307	0.03	2	0.045	0.03	0.7 5	18.0-20.0	8.0-12.0	...	0.1	Bal.	1.4307	92 HRB	485	170	40	...	The differences between each of the German standards are based on the product form and whether the metal is plate or has been hot or cold-rolled. The strength of 304L stainless steel increases with cold work from the cold-rolling process and therefore the cold-rolled stainless steel typically exhibits on average higher tensile and yield strengths. These German standards are equivalent to the 304L standards for all of the countries presented here for 304L. Hardness Values for EN 10088 are solution annealed.
		DIN EN 10088-2:2005 Cold Rolled Strip	Stainless Steel Flat Products for General Purposes	X2 CrNi18-9; 1.4307	0.03	2	0.045	0.015	1	17.50 - 19.50	8-10.5	...	0.1 1	Bal.	X2 CrNi18-9; 1.4307	79 HRB	520-700	220	45	....
		DIN EN 10088-2:2005 Hot Rolled Strip	Stainless Steel Flat Products for General Purposes	X2 CrNi18-9; 1.4307	0.03	2	0.045	0.015	1	17.50 - 19.50	8-10.5	...	0.1 1	Bal.	X2 CrNi18-9; 1.4307	79 HRB	520-700	220	45	100 J (Longitudinal), 60 J(Transverse)	
		DIN EN 10088-2:2005 Hot Rolled Plate	Stainless Steel Flat Products for General Purposes	X2 CrNi18-9; 1.4307	0.03	2	0.045	0.015	1	17.50 - 19.50	8-10.5	...	0.1 1	Bal.	X2 CrNi18-9; 1.4307	79 HRB	500-700	200	45	100 J (Longitudinal), 60 J(Transverse)	
	Japan	JIS G4303: 2005	Japanese Standards Association for Specification for hot worked Stainless Steel Bars with different shapes.	SUS 304L	0.03	2	0.045	0.03	1	18.0-20.0	9.0-13.0	Bal.	SUS 304L	90 HRB	min. 480	min. 175	40	...	This Japanese standard for 304L stainless steel is equivalent to all of the countries presented here for 304L.
	China	GB/T 4237-2015	Hot Rolled Stainless Steel Plate, Sheet, and Strip	S30403 / 022Cr19Ni10	0.03	2	0.045	0.03	0.7 5	17.50 - 19.50	8.0-12.0	...	0.1	Bal.	S30403 / 022Cr19Ni 10	92 HRB	min. 485	min. 180	40	...	The Chinese standards are equivalent to one another with the only variations being due to the method of processing. These Chinese standards for 304L are equivalent to all of the other countries presented here.
		GB/T 3280-2015	Cold Rolled Stainless Steel Plate, Sheet, and Strip;	S30403 / 022Cr19Ni10	0.03	2	0.045	0.03	0.7 5	17.50 - 19.50	8.0-12.0	...	0.1	Bal.	S30403 / 022Cr19Ni 10	92 HRB	min. 485	min. 180	40	...	
		GB/T20878-2007	Stainless and Heat Resisting Steels- Designation and Chemical Composition	S30403 / 022Cr19Ni10	0.03	2	0.045	0.03	0.7 5	18.0-20.0	8.0-12.0	...	...	Bal.	S30403 / 022Cr19Ni 10	...	...	...	...	...
ATS Material Stainless Steel					Chemical Composition Weight Percent											Mechanical Properties					Additional Notes
	Country	Standard	Standard Specification	Grade	C	Mn	P Max	S Max	Si	Cr	Ni	Mo	N	Fe		Hardness (Rockwell) max.	Ultimate Tensile Strength (Mpa)	Yield Strength (Mpa)	Percent Elongation	Impact Toughness (Joules)	
316	USA	AISI/ASTM A240	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications	316	0.08	2	0.045	0.03	0.7 5	16.0-18.0	10.0-14.0	2.0-3.0	0.1	Bal.	316	95 HRB	min. 515	min. 205	40	...	These USA based standards presented here are the typical properties for 316 stainless steels for plate, sheet, and strip. The ultimate tensile strengths and yield strengths may be higher for cold-worked materials. These USA standards are equivalent to the 316 standards for all of the countries presented here for 316

		ASTM A666-15	Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar	316	0.08	2	0.045	0.03	0.7 5	16.0-18.0	10.0-14.0	2.0-3.0	...	Bal.	316	95 HRB	min. 515	min. 205	40	...		
	Germany	DIN EN 10088-2:2005 Cold Rolled Strip	Stainless Steel Flat Products for General Purposes	X5 CrNiMo 17-12-2, 1.4401	0.07	2	0.045	0.015	1	16.5-18.5	10.0-13.0	2.0-2.5	0.1 1	Bal.	X5 CrNiMo 17-12-2, 1.4401	79 HRB (solution annealed)	530-680	min. 240	40	...	The differences between each of the German standards are based on the product form and whether the metal is plate or has been hot or cold-rolled. The strength of 316 stainless steel increases with cold work from the cold-rolling process and therefore the cold-rolled stainless steel typically exhibits on average higher tensile and yield strengths. These German standards are equivalent to the 316 standards for all of the countries presented here for 316. Hardness Values for EN 10088 are solution annealed.	
		DIN EN 10088-2:2005 Hot Rolled Strip	Stainless Steel Flat Products for General Purposes	X5 CrNiMo 17-12-2, 1.4401	0.07	2	0.045	0.015	1	16.5-18.5	10.0-13.0	2.0-2.5	0.1 1	Bal.	X5 CrNiMo 17-12-2, 1.4401	79 HRB (solution annealed)	530-680	min. 240	40	100 J (Longitudinal), 60 J(Transverse)		
		DIN EN 10088-2:2005 Hot Rolled Plate	Stainless Steel Flat Products for General Purposes	X5 CrNiMo 17-12-2, 1.4401	0.07	2	0.045	0.015	1	16.5-18.5	10.0-13.0	2.0-2.5	0.1 1	Bal.	X5 CrNiMo 17-12-2, 1.4401	81 HRB (solution annealed)	520-670	min. 220	45	100 J (Longitudinal), 60 J(Transverse)		
	Japan	JIS G4303: 2005	Japanese Standards Association for Specification for hot worked Stainless Steel Bars with different shapes.	SUS 316	0.08	2	0.045	0.03	1	16.0-18.0	10.0-14.0	2.0-3.0	...	Bal.	SUS 316	90 HRB	520	205	40	...	This Japanese standard for 316 stainless steel is equivalent to all of the countries presented here for 316.	
	China	GB/T 4237-2007	Hot Rolled Stainless Steel Plate, Sheet, and Strip	S31608 / 06Cr17 Ni12Mo 2	0.08	2	0.045	0.03	0.7 5	16.0-18.0	10.0-14.0	2.0-3.0	0.1	Bal.	S31608 / 06Cr17Ni1 2Mo2	95 HRB	515	205	40	...	The Chinese standards are equivalent to one another with the only variations being due to the method of processing. These Chinese standards for 316 are equivalent to all of the other countries presented here.	
		GB/T 3280-2007	Cold Rolled Stainless Steel Plate, Sheet, and Strip;	S31608 / 06Cr17 Ni12Mo 2	0.08	2	0.045	0.03	0.7 5	16.0-18.0	10.0-14.0	2.0-3.0	0.1	Bal.	S31608 / 06Cr17Ni1 2Mo2	95 HRB	515	205	40	...		
		GB/T20878-2007	Stainless and Heat Resisting Steels-Designation and Chemical Composition	S31608 / 06Cr17 Ni12Mo 2	0.08	2	0.045	0.03	1	16.0-18.0	10.0-14.0	2.0-3.0	...	Bal.	S31608 / 06Cr17Ni1 2Mo2	...	...	...	...	...
	ATS Material Stainless Steel					Chemical Composition Weight Percent											Mechanical Properties					
Country		Standard	Standard Specification	Grade	C	Mn	P Max	S Max	Si	Cr	Ni	Mo	N	Fe	Grade	Hardness (Rockwell) max.	Ultimate Tensile Strength (Mpa)	Yield Strength (Mpa)	Percent Elongation	Impact Toughness (Joules)	Additional Notes	
316L	USA	AISI/ASTM A240	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications	316L	0.03	2	0.045	0.03	0.7 5	16.0-18.0	10.0-14.0	2.0-3.0	0.1	Bal.	316L	95 HRB	min. 485	min. 170	40	...	These USA based standards presented here are the typical properties for 316L stainless steels for plate, sheet, and strip. The ultimate tensile strengths and yield strengths may be higher for cold-worked materials. These USA standards are equivalent to the 316L standards for all of the countries presented here for 316L.	
		ASTM A666-15	Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar	316L	0.03																	
	Germany	DIN EN 10088-2:2005 Cold Rolled Strip	Stainless Steel Flat Products for General Purposes	X2 CrNiMo 17-12-2, 1.4404	0.030											0.045	0.015	1.0 00	16.5-18.5	10.0-13.0	2.0-2.5	0.1 10	Bal.	X2 CrNiMo 17-12-2, 1.4404	79 HRB (solution annealed)	530-680	min. 240	40	...	The differences between each of the German standards are based on the product form and whether the metal is plate or has been hot or cold-rolled. The strength of 316L stainless steel

		DIN EN 10088-2:2005 Hot Rolled Strip	Stainless Steel Flat Products for General Purposes	X2 CrNiMo 17-12-2, 1.4404	0.030		0.045	0.015	1.000	16.5-18.5	10.0-13.0	2.0-2.5	0.110	Bal.	X2 CrNiMo 17-12-2, 1.4404	79 HRB (solution annealed)	530-680	min. 240	40	100 (Longitudinal), 60 (Transverse)	increases with cold work from the cold-rolling process and therefore the cold-rolled stainless steel typically exhibits on average higher tensile and yield strengths. These German standards are equivalent to the 316L standards for all of the countries presented here for 316L. Hardness values for EN 10088 are solution annealed
		DIN EN 10088-2:2005 Hot Rolled Plate	Stainless Steel Flat Products for General Purposes	X2 CrNiMo 17-12-2, 1.4404	0.030		0.045	0.015	1.000	16.5-18.5	10.0-13.0	2.0-2.5	0.110	Bal.	X2 CrNiMo 17-12-2, 1.4404	81 HRB (solution annealed)	520-670	min. 220	45	100 (Longitudinal), 60 (Transverse)	
	Japan	JIS G4303: 2005	Japanese Standards Association for Specification for hot worked Stainless Steel Bars with different shapes.	SUS 316L	0.030		0.045	0.03	1	16.0-18.0	12.0-15.0	2.0-3.0	...	Bal.	SUS 316L	90 HRB	480	175	40	...	This Japanese standard for 316L stainless steel is equivalent to all of the countries presented here for 316L.
	China	GB/T 4237-2007	Hot Rolled Stainless Steel Plate, Sheet, and Strip	S31603 / 022Cr17Ni12Mo2	0.03		0.045	0.03	0.75	16.0-18.0	10.0-14.0	2.0-3.0	0.1	Bal.	S31603 / 022Cr17Ni12Mo2	95 HRB	485	180	40	...	The Chinese standards are equivalent to one another with the only variations being due to the method of processing. These Chinese standards for 316L are equivalent to all of the other countries presented here.
		GB/T 3280-2007	Cold Rolled Stainless Steel Plate, Sheet, and Strip;	S31603 / 022Cr17Ni12Mo2	0.03		0.045	0.03	0.75	16.0-18.0	10.0-14.0	2.0-3.0	0.1	Bal.	S31603 / 022Cr17Ni12Mo2	95 HRB	485	180	40	...	
		GB/T20878-2007	Stainless and Heat Resisting Steels-Designation and Chemical Composition	S31603 / 022Cr17Ni12Mo2	0.030		0.045	0.03	1.000	16.0-18.0	10.0-14.0	2.0-3.0	...	Bal.	S31603 / 022Cr17Ni12Mo2	...	...	...	...	...
ATS Material Stainless Steel					Chemical Composition Weight Percent											Mechanical Properties					
	Country	Standard	Standard Specification	Grade	C	Mn	P Max	S Max	Si	Cr	Ni	Mo	N	Fe	Grade	Hardness (Rockwell) max.	Ultimate Tensile Strength (Mpa)	Yield Strength (Mpa)	Percent Elongation	Impact Toughness (Joules)	Additional Notes
440C	USA	ASTM A276	Standard Specification for Stainless Steel Bars and Shapes	440C	0.95-1.20		0.04	0.03	1.0	16.0-18.0	...	0.75	...	...	440C	104 HRB (Hot finished), 105.5 HRB (Cold Finished)	...	...	...	...	Annealed Condition. This specification covers hot-finished or cold-finished bars except bars for reforging. It includes rounds, squares, and hexagons, and hot-rolled or extruded shapes, such as angles, tees, and channels in the more commonly used types of stainless steels. Equivalent to other 440C steels.
		ASTM A473	Standard Specification for Stainless Steel Forgings	440C	0.95-1.20		0.04	0.03	1.0	16.0-18.0	...	0.75	...	Bal.	440C	104 HRB	...	...	...	...	Annealed Condition. This specification covers austenitic, austenitic-ferritic, ferritic, and martensitic stainless steel forgings for general use, and for low- or high-temperature service. Equivalent to other 440C steels.
		UNS S44004	Hot Rolled, Annealed	440C	...		...	...	...	...	...	...	440C	104 HRB	758	448	14	...	Hot Rolled, Annealed, Bars, Typical Values According to UNS S440004 steel 440C. Equivalent to other 440C steels		
			Cold Drawn										440C	105.5 HRB	862	689	7		Cold Drawn, Bars, Typical Values According to UNS S440004 steel 440C. Equivalent to other 440C steels		
	Germany	DIN EN 10088-1:2005	Stainless steels - Part 1: List of stainless steels	X105CrMo17 / 1.4125	0.95-1.20		0.04	0.015	1.0	16.0-18.0	...	0.40 - 0.80	...	Bal.	X105CrMo 17 / 1.4125	105.5 HRB	...	...	...	...	This German/European standard covers Hot Formed, Annealed Material for stainless steels.
	Japan	JIS G4303: 2005	Japanese Standards Association for Specification for hot worked Stainless Steel Bars with different shapes.	SUS440C	0.95-1.20		0.04	0.03	1.0	16.0-18.0	...	0.75	...	Bal.	SUS440C	58 HRC	...	...	...	...	This Japanese standard covers hot worked stainless steel bars of different shapes. SUS440C is equivalent to 440C.

	China	GB/T 1280-2007	Stainless Steel Bars	108Cr17	...	...	...	...	...	...	...	...	...	108Cr17	58 HRC	...	...	...	...
		GB/T20878-2007	Stainless and Heat Resisting Steels-Designation and Chemical Composition	S44096 / 108Cr17 / 11Cr17	0.95-1.20		0.04	0.03	1	16.0-18.0	0.6	0.75	...	Bal.	S44096 / 108Cr17 / 11Cr17

- General Steel

ATS Material General Steel					Chemical Composition Weight Percent											Grade	Mechanical Properties					Additional Notes
	Country	Standard	Standard Specification	Grade	C	Mn	P Max	S Max	Si	Cr	Ni	Mo	Cu	N	Fe		Hardness (Rockwell) max.	Ultimate Tensile Strength (Mpa)	Yield Strength (Mpa)	Percent Elongation	Impact Toughness (Joules)	
4140	USA	ASTM A506	Standard Specification for Alloy and Structural Alloy Steel, Sheet and Strip, Hot-Rolled and Cold-Rolled	AISI / SAE 4140	0.38-0.43	0.75-1.0	0.035	0.035	0.15-0.30	0.8-1.10	...	0.15-0.25	...	...	Bal.	AISI / SAE 4140	...	....	...	...	...	These specifications cover chemical and some mechanical requirements of hot-rolled and cold-rolled alloy and structural 4140 alloy-steel sheet and strip. These 4140 grades are equivalent to the other countries shown. Cold-rolled steels will have more anisotropy than the hot-rolled steels because the grains become elongated in the cold-rolled condition. Cold-rolled steels also have higher residual stresses because they are not relieved through temperature.
		AMS 6395	Aerospace Material Specification: Steel Sheet, Plate, and Strip	AISI / SAE 4140			0.025	0.025	0.15-0.35		0.25		0.35			AISI / SAE 4140	Max. 98 HRB	min. 1241				
	Germany	DIN EN 10083-3	Steels for Quenching and tempering - Part 3: Technical Delivery conditions for alloy steels	42CrMo4 / 1.7225	0.38-0.45	0.6-0.9	0.025	0.035	Max. 0.4	0.9-1.20	...	0.15-0.30	...	...	Bal.	42CrMo4 / 1.7225	Max. 241 HBW (soft annealed)	750-1300	500-900	10-14	35 J	DIN 17200/17212 is Germany-only version, now using DIN EN 10083-3 (European). EN 10083 specifies the technical delivery requirements for many shapes and forms including soft annealed and quenched and tempered hot rolled strip and sheet/plate. ISO 683-2 also covers 'Heat-treatable steels, alloy steels and free-cutting steels -- Part 2: Alloy steels for quenching and tempering'. Mechanical properties vary with diameter or thickness of steel. Equivalent to all 4140 steels presented. Remember that microstructure is performance. The variations in microstructure, not chemistry, affect the performance and the mechanical properties. A quench and tempered martensitic microstructure will have dramatically different mechanical properties than a ferritic-pearlitic steel even though they have the same chemistry.
	Japan	JIS G4105:1979	Chromium-Molybdenum Steels	SCM 440	0.38-0.43	0.6-0.8	0.03	0.03	0.15-0.35	0.9-1.20	0.25	0.15-0.30	0.35	...	Bal.	SCM 440	285-352 HB	981	834	12	59 J	This Japanese standard for 4140 steel is equivalent to all of the countries presented here for 4140.
	China	GB/T 4237-2015	National Standard of PRC Alloy Structure Steels	42CrMo	0.38-0.45	0.5-0.8	0.035	0.035	0.17-0.37	0.9-1.20	0.3	0.15-0.25	0.3	...	Bal.	42CrMo	Max. 217 HB	1,080	930	12	63	This Chinese standard for 4140 is equivalent to all of the other countries presented here. Mechanical properties are for heat treated specimen of size 25mm. The standard covers the following issues of hot rolled and forging alloy steel: the dimension, shape, weight,

																						tolerance, engineering specification, test method, inspection rules, packaging, marking, and quality certificates.	
ATS Material General Steel					Chemical Composition Weight Percent													Mechanical Properties					
	Country	Standard	Standard Specification	Grade	C	Mn	P Max	S Max	Si	Cr	Ni	Mo	Cu	N	Fe	Grade	Hardness (Rockwell) max.	Ultimate Tensile Strength (Mpa)	Yield Strength (Mpa)	Percent Elongation	Impact Toughness (Joules)	Additional Notes	
C-1018	USA	ASTM A794	Standard Specification for Commercial Steel (CS), Sheet, Carbon (0.16 % Maximum to 0.25 % Maximum), Cold-Rolled	1018	0.14-0.20	0.6-0.9	0.03	0.035	...	...	...	...	...	...	Bal.	1018	...	...	...	...	...	This USA, ASTM specification covers cold-rolled commercial steel (CS) sheet in coils and cut lengths, in which the maximum of the specified carbon range is over 0.15 and not over 0.25 %, and the maximum of the specified manganese range is not over 0.90 %. This spec includes 1018 structural steel chemical properties, but not mechanical. The mechanical properties can vary greatly based on the microstructure in terms of grain size and pearlite content.
	Germany	DIN EN 10016-2	Non-alloy Steel Rod for Drawing and or Cold Rolling	C18D / 1.0416	0.15-0.20	0.3-0.6	0.035	0.035	0.3	0.2	0.25	0.05	0.3	...	Bal.	C18D / 1.0416	...	...	...	...	...	DIN 17140 is a German Standard, Germany also falls under DIN EN 10016-2 (European). Aside from slight manganese content differences, the C18D is presumed equivalent to 1018 as a structural steel. The difference in manganese affects the hardenability of the steel, which is similar to the role of carbon but to a lesser extent meaning that the manganese variations will not affect the performance of the steel.
	Japan	JIS G 3108	Rolled Carbon Steel for Cold-Finished Steel Bar	S18C	0.15-0.20	0.3-0.6	0.03	0.035	0.15-0.35	..	...	...	...	...	Bal.	S18C	...	...	...	...	...	This Japanese standard includes structural steel presumed equivalent to 1018.
	China	GB/T 699	Quality Carbon Structural Steels	U20202 / 20		0.3-0.6	0.035	0.035	0.17-0.37	0.25	0.3	...	0.25 5	...	Bal.	U20202 / 20	156 HBS	450	275	25	...	This Chinese standard for 4140 is equivalent to all of the other countries presented here. Mechanical properties are for heat treated specimen of size 25mm. The standard covers the following issues of hot rolled and forging alloy steel: the dimension, shape, weight, tolerance, engineering specification, test method, inspection rules, packaging, marking, and quality certificates.	
			U21202 / 20Mn	0.7-1.0																			
ATS Material General Steel					Chemical Composition Weight Percent													Mechanical Properties					
	Country	Standard	Standard Specification	Grade	C	Mn	P Max	S Max	Si	Cr	Ni	Mo	Cu	N	Fe	Grade	Hardness (Rockwell) max.	Ultimate Tensile Strength (Mpa)	Yield Strength (Mpa)	Percent Elongation	Impact Toughness (Joules)	Additional Notes	
A36	USA	ASTM A36	Standard Specification for Carbon Structural Steel	A36 / UNS K02600	0.25-0.29	0-1.20	0.04	0.05	0.15-0.40	...	...	...	0.2	...	Bal.	A36 / UNS K02600	...	400-550	250	20-23	...	Over certain thicknesses, manganese content requirement can increase. Mechanical properties and elongation vary with shape and thickness. Check ASTM A 36

	Germany	DIN 17100	Steels for General Structural Purposes (Delivered Hot Formed or Normalized)	ST44-2 / 1.0044	0.21-0.25	...	0.06	0.06	...	...	...	...	...	0.01	Bal.	ST44-2 / 1.0044	...	410-580	235-275	12-22	27 J	This Standard applies to steel sections (including wide flange beams), steel bars, wire rod, flat products (strip, plate, wide flats).... which are delivered in the hot formed or normalized condition after production. Mechanical Properties vary with thickness and shape of specimen.
		EN 10025-2	Hot rolled products of structural steels — Part 2: Technical delivery conditions for non-alloy structural steels	S275JR	0.21-0.25	max 1.6	0.045	0.045	...	...	...	...	0.6	0.014	Bal.	S275JR	...	380-580	205-275	15-23	27 J	European standard which specify the technical delivery conditions for hot rolled products of structural steels. Mechanical properties vary with thickness and shape.
	Japan	JIS G 3101	Rolled steels for general structure	SS400	...	...	0.05	0.05	Max. 0.35	...	....	...	...	...	Bal.	SS400	...	400-510	205-245	17-23	...	This Japanese Industrial Standard specifies the hot rolled steels used for general structure such as bridges, ships, rolling stocks and other structures. Carbon and manganese chemical composition are not specified.
	China	GB/T 700	Carbon Structural Steels	Q215	0.15	1.2	0.045	0.05	0.35	...	...	...	...	...	Bal.	Q215	...	335-450	165-215	26-31	27J @ 20°C (Grade B)	This Standard specifies the grade, dimension, shape, weight, permissible deviation, technical requirements, test methods, inspection rules, packing, marking, and quality certificate of carbon structural steel. This Standard is applicable to the structural hot rolled steel sheets, steel strips, sectional steels, and bar steels that are generally used for welding, riveting and bolting engineering in delivery state.
Q235				0.17-0.22	1.4	Q235										375-500		185-235	21-26	27 J		
				0.20-0.24	1.5	Q275										410-540		215-275	17-22			

ATS Material General Steel					Chemical Composition Weight Percent												Mechanical Properties					
	Country	Standard	Standard Specification	Grade	C	Mn	P Max	S Max	Si	Cr	Ni	Mo	Cu	N	Fe	Grade	Hardness (Rockwell) max.	Ultimate Tensile Strength (Mpa)	Yield Strength (Mpa)	Percent Elongation	Impact Toughness (Joules)	Additional Notes
A 500	USA	ASTM A500	Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes	Grade A	0.26-0.30	1.35-1.40	0.045	0.045	...	...	...	...	0.18-0.20	...	Bal.	Grade A	...	310	230-270	25	...	This specification covers four grades of A500 structural steel, cold-formed welded and seamless carbon steel round, square, rectangular, or special shape structural tubing for welded, riveted, or bolted construction of Bridges and buildings, and for general structural purposes. Mechanical properties and Elongation vary with shape (round rectangular vs square) and thickness.
				Grade B												Grade B		400	290-315	23		
				Grade C	0.23-0.27											Grade C		425	315-345	21		
				Grade D	0.26-0.30											Grade D		400	250	23		
	Germany	DIN EN 10219-1	Cold Formed Structural hollow sections of non-alloy quality steels	S235JRH / 1.0039	0.17	1.4	0.04	0.04	...	...	...	...	...	0.009	Bal.	S235JRH / 1.0039	...	360-510	235-275	24	27 J @ 20°C	This part of this German/European Standard specifies the technical delivery conditions for cold formed welded structural hollow sections of circular, square or rectangular forms and applies to structural hollow sections formed cold without subsequent heat treatment. Mechanical properties vary with thickness of specimen. The grades presented in the
				S275J0H / 1.0149	0.2	1.5	0.035	0.035								S275J0H / 1.0149		410-580	275	20	27 J @ 0°C	
				S275J2H / 1.0138			0.03	0.03								S275J2H / 1.0138					27 J @ -20°C	

				S355J0 H / 1.0547	0.22	1.6	0.035	0.035	0.55					0.009		S355J0H / 1.0547		470- 680	355		27 J @ 0°C	European/German standard are presumed equivalent to the A500 steels. Many of the grades solely differ by their energy impact values at differing temperatures. The difference in properties between each grade is due to slight variations in the microstructure. The specific grade should be specified based on desired properties.				
			S355J2 H / 1.0576	0.03			0.03	...						S355J2H / 1.0576		27 J @ -20°C										
			S355K2 H / 1.0512											S355K2H / 1.0512		40 J @ -20°C										
Japan	JIS G 3444	Carbon steel tubes for general structural purposes	STK 290	...	...	0.05	0.05	...	...	...	...	...	...	Bal.	STK 290	...	290	...	20-30	...	These Japanese standards cover square and round carbon steel tubes (welded and seamless) for structural purposes. They are presumed equivalent to the various A500 grade steels.
			STK 400	0.25	...	0.04	0.04										Bal.	STK 400	400	235	18-23
			STK 490	0.18	1.5																		STK 490	490	315	
			STK 500	0.24	0.3-1.30																		STK 500	500	355		10-15
	JIS G 3446	Carbon steel square for general structural purposes	STKR 400	0.25	Prepared By: Angelique Lasseigne, PhD Joshua Jackson, PhD	0.04	0.04	...	...	...	...	...	Bal.	STKR 400	...	400	245	23	...		
			STKR 490	0.18										STKR 490		490	325									
	China	GB/T 8162	Seamless Tubes For Structural Purposes	Q235		0.17-0.22	0.03	0.03	0.35	0.3	0.3	...	0.2	Q235	...	375-500	215-235	25	27	These two Chinese standards cover chemical and mechanical requirements for seamless and welded non-alloy carbon steel for structural purposes. Properties and carbon content vary with the grade. Presumed equivalent to A500 structural steels.			
				Q275		0.20-0.24											Q275		415-540	255-275	22					
GB/T 13793		Longitudinal electric resistance welded steel tubes	Q215	...		...	...	...	...	...	...	...	...	Q215	...	335	...	22	...		
			Q235											Q235		375	20									

- Tool Steel

ATS Material Tool Steel					Chemical Composition Weight Percent											Mechanical Properties					Additional Notes
	Country	Standard	Standard Specification	Grade	C	Mn	P Max	S Max	Si	Cr	V	W	Mo	Fe		Hardness (Rockwell) max.	Ultimate Tensile Strength (Mpa)	Yield Strength (Mpa)	Percent Elongation	Impact Toughness (Joules)	
O1	USA	ASTM A 681	Standard Specification for Tool Steels Alloy	O1 / T31501 (UNS)	0.85-1.0	1.0-1.4	0.03	0.03	0.1-0.5	0.4-0.7	0.3	0.4-0.6	...	Bal.	O1 / T31501 (UNS)	212 BHN (Annealed), 241 BHN (Cold Drawn), Min. 59 HRC (quench + temper)	...	....	...	...	This specification covers the chemical, mechanical, and physical requirements for available wrought alloy tool steel products. These products, which include hot or cold finished bar, plate, sheet, strip. This O1 is equivalent to all other tool steels in this section. The hardness is the only mechanical property utilized to characterize tool steels per the standards.
	Germany	DIN 17350/ EN ISO 4957	Tool Steels	1.2510 / 100MnCrW4	0.9-1.05	1.0-1.20	0.035	0.035	0.15-0.35	0.5-0.7	0.015 - 0.15	0.5-0.7	...	Bal.	1.2510 / 100MnCrW4	max. 230 HB (anneal), 55-64 HRC (quench+temper)	...	...	...	...	DIN 17350 is equivalent to European EN / ISO 4957. 1.2510 is equivalent to O1 Tool steel.
	Japan	JIS G 4404:2000	Alloy Tool Steels	SKS3	0.9-1.0	0.9-1.20	0.03	0.03	0.35	0.5-1.0	...	0.5-1.0	...	Bal.	SKS3	max. HB 217 (annealed). Min 60 HRC (quench+temper)	...	...	...	...	This Japanese Industrial Standard has been prepared based on the corresponding international standard, ISO 4957: 1998 Tool Steels. SKS3 is equivalent to O1 tool steel.
	China	GB / T 1299-2000	Alloy Tool Steels	9CrWMn	0.85-0.95	0.9-1.20	0.03	0.03	0.4	0.5-0.8	...	0.5-0.8	...	Bal.	9CrWMn	197-247 HBW (anneal) , 62 HRC (quench + temper)	...	...	...	...	This Standard specifies the classification tool and die steel for China. It is equivalent to O1 tool steel.
ATS Material Tool Steel					Chemical Composition Weight Percent											Mechanical Properties					Additional Notes
	Country	Standard	Standard Specification	Grade	C	Mn	P Max	S Max	Si	Cr	V	W	Mo	Fe		Hardness (Rockwell) max.	Ultimate Tensile Strength (Mpa)	Yield Strength (Mpa)	Percent Elongation	Impact Toughness (Joules)	
A2	USA	ASTM A 681	Standard Specification for Tool Steels Alloy	T30102 (UNS) / A2	0.95-1.05	0.4-1.0	0.03	0.03	0.1-0.5	4.75-5.50	0.15-0.5	...	0.9-1.40	Bal.	T30102 (UNS) / A2	248 BHN (Annealed), 262 BHN (Cold Drawn), Min. 60	...	...	...	...	This specification covers the chemical, mechanical, and physical requirements for available wrought alloy tool steel products. These products, which include hot or cold finished bar, plate, sheet, strip... This A2

																HRC (quench + temper)					is equivalent to all other tool steels in this section. The hardness is the only mechanical property utilized to characterize tool steels per the standards.
	Germany	DIN 17350/ EN ISO 4957	Tool Steels	1.2363 / X100CrMo V5	0.95-1.05	0.4-0.8	0.03	0.03	0.1-0.4	4.8-5.50	0.15-0.35	...	0.9-1.20	Bal.	1.2363 / X100CrMoV5	max. 241 HB (anneal), min. 60 HRC (quench+temper)	...	...	...	...	DIN 17350 is equivalent to European EN / ISO 4957. 1.2363 is equivalent to A2 Tool steel.
	Japan	JIS G 4404:2000	Alloy Tool Steels	SKD12	0.95-1.05	0.4-0.8	0.03	0.03	0.1-0.4	4.8-5.50	0.15-0.35	...	0.9-1.20	Bal.	SKD12	max. HB 241 (annealed). Min 60 HRC (quench+temper)	...	...	...	...	This Japanese Industrial Standard has been prepared based on the corresponding international standard, ISO 4957: 1998 Tool Steels. SKD12 is equivalent to A2 tool steel.
	China	GB / T 1299-2000	Alloy Tool Steels	Cr5Mo1V / XW-10	0.95-1.05	Max 1.0	0.03	0.03	Max. 0.5	4.75-5.50	0.15-0.5	...	0.9-1.40	Bal.	Cr5Mo1V	Max. 255 HBW (anneal) , 60 HRC (quench + temper)	...	...	...	...	This Standard specifies the classification tool and die steel for China. Cr5Mo1V and XW-10 are equivalent to A2 tool steel. XW-10 is a trade name for A2 Tool Steel by the steel producer ASSAB.
ATS Material Tool Steel					Chemical Composition Weight Percent											Mechanical Properties					
	Country	Standard	Standard Specification	Grade	C	Mn	P Max	S Max	Si	Cr	V	W	Mo	Fe	Grade	Hardness (Rockwell) max.	Ultimate Tensile Strength (Mpa)	Yield Strength (Mpa)	Percent Elongation	Impact Toughness (Joules)	Additional Notes
D2	USA	ASTM A 681	Standard Specification for Tool Steels Alloy	T30402 (UNS) / D2	1.4-1.6	0.1-0.6	0.03	0.03	0.1-0.6	11.0-13.0	0.5-1.10	...	0.7-1.20	Bal.	T30402 (UNS) / D2	255 BHN (Annealed), 269 BHN (Cold Drawn), Min. 59 HRC (quench + temper)	...	...	...	...	This specification covers the chemical, mechanical, and physical requirements for available wrought alloy tool steel products. These products, which include hot or cold finished bar, plate, sheet, strip. This D2 is equivalent to all other tool steels in this section. The hardness is the only mechanical property utilized to characterize tool steels per the standards.
	Germany	DIN 17350/ EN ISO 4957	Tool Steels	1.2379 / X153CrMo V12	1.45-1.6	0.2-0.6	0.03	0.03	0.1-0.6	11.0-13.0	0.7-1.0	...	0.7-1.0	Bal.	1.2379 / X153CrMoV1 2	max. 255 HB (anneal), min. 61 HRC (quench+temper)	...	...	...	...	DIN 17350 is equivalent to European EN / ISO 4957. 1.2379 is equivalent to D2 Tool steel.
	Japan	JIS G 4404:2000	Alloy Tool Steels	SKD10	1.4-1.6	0.2-0.6	0.03	0.03	0.1-0.6	11.0-13.0	0.7-1.0	...	0.8-1.20	Bal.	SKD10	max. HB 255 (annealed). Min 61 HRC (quench+temper)	...	...	...	...	This Japanese Industrial Standard has been prepared based on the corresponding international standard, ISO 4957: 1998 Tool Steels. SKD10 is equivalent to D2 tool steel.
	China	GB / T 1299-2000	Alloy Tool Steels	Cr12Mo1V 1	1.4-1.6	max 0.6	0.03	0.03	max. 0.6	11.0-13.0	0.5-1.10	...	0.7-1.20	Bal.	Cr12Mo1V1	Max. 255 HBW (anneal) , 59 HRC (quench + temper)	...	...	...	...	This Standard specifies the classification tool and die steel for China. Cr12Mo1V1 is equivalent to D2 tool steel.

- Aluminum

ATS Material Aluminum					Chemical Composition Weight Percent											Mechanical Properties					
	Country	Standard	Standard Specification	Grade/ Temper	Si	Fe	Cu	Mn	Mg	Cr	Zn	Ti	Other Elements	Al	Grade/ Temper	Hardness (Rockwell) max.	Ultimate Tensile Strength (Mpa)	Yield Strength (Mpa)	Percent Elongation	Impact Toughness (Joules)	Additional Notes
6061-T6	USA	AISI/ASTM B209M/209-14	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)	6061-T6	0.40-0.80	0.7	0.15-0.40	0.15	0.8-0.12	0.04-0.35	0.25	0.15	0.05 (Single), 0.15 (Total)	Bal.	6061-T6	...	290	240	4.0-10.0	...	This specification covers aluminum and aluminum- alloy flat sheet, coiled sheet, and plate. Elongation properties vary with thickness. Equivalent to the other 6061-T6 standards presented.
		ASTM B308	Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles	6061-T6	0.40-0.80	0.7	0.15-0.40	0.15	0.8-0.12	0.04-0.35	0.25	0.15	0.05 (Single), 0.15 (Total)	Bal.	6061-T6	89-90 HRE	260	240	10	...	This specification covers extruded 6061-T6 aluminum- alloy standard structural profiles. The profiles are limited to I-beams, H-beams, channels, angles, tees, and zees. Equivalent to the other 6061-T6 standards.
	Germany	DIN EN 573-3 (Chemical) & DIN EN 755-2 (Mechanical)	Aluminum and aluminum alloys - Chemical Composition and Form of Products / Sheet, strip and plate	EN-AW 6061 / AlMg1SiCu	0.40-0.80	0.7	0.15-0.40	0.15	0.8-0.12	0.04-0.35	0.25	0.15	0.05 (Single), 0.15 (Total)	Bal.	EN-AW 6061 / AlMg1SiCu	80-88 HBW	260-290	220-240	6.0-10.0	...	German/European standard covering T6-Solution heat treated, quenched and artificially aged, (T6 properties can be achieved by press quenching) 6061

																					aluminum. Mechanical Properties vary with Thickness of plate. Equivalent to the 6061-T6.
	Japan	JIS H 4000:2014	Aluminium and aluminium alloy sheets, strips and plates	A6061P / 6061-T6	0.40-0.80	0.7	0.15-0.40	0.15	0.8-0.12	0.04-0.35	0.25	0.15	0.05 (Single), 0.15 (Total)	Bal.	A6061P / 6061-T6	...	min. 294	min. 245	8.0-10.0	...	For Plate, Coil & Circular. Elongation varies with thickness. Equivalent to the 6061-T6 standards presented
	China	GB/T 3190-2008 (Chemical) & GB/T 3880.2 (Mechanical)	Wrought Aluminium and Aluminium Alloy – Chemical Composition	6061-T6	0.40-0.80	0.7	0.15-0.40	0.15	0.8-0.12	0.04-0.35	0.25	0.15	0.05 (Single), 0.15 (Total)	Bal.	6061-T6	...	260	240	10	...	This Chinese standard covers wrought aluminum chemical and mechanical properties of equivalent 6061-T6 steel.
ATS Material Aluminum					Chemical Composition Weight Percent											Mechanical Properties					
	Country	Standard	Standard Specification	Grade/ Temper	Si	Fe	Cu	Mn	Mg	Cr	Zn	Ti	Other Elements	Al	Grade/ Temper	Hardness (Rockwell) max.	Ultimate Tensile Strength (Mpa)	Yield Strength (Mpa)	Percent Elongation	Impact Toughness (Joules)	Additional Notes
3003-H14	USA	AISI/ASTM B209M/209-14	Standard Specification for Aluminum and Aluminum- Alloy Sheet and Plate (Metric)	3003-H14	0.6	0.7	0.05-0.2	1.0-1.5	...	...	0.1	...	0.05 (Single), 0.15 (Total)	Bal.	3003-H14	...	min. 140, max. 180	115	1.0-2.0	...	This specification covers aluminum and aluminum- alloy flat sheet, coiled sheet, and plate. Elongation properties vary with thickness. Equivalent to the other 3003-H14 standards presented.
	Germany	DIN EN 573-3 (Chemical) & DIN EN 755-2 (Mechanical)	Aluminum and aluminum alloys - Chemical Composition and Form of Products / Sheet, strip and plate	EN-AW 3003 / AlMn1Cu	0.6	0.7	0.05-0.2	1.0-1.5	...	...	0.1	...	0.05 (Single), 0.15 (Total)	Bal.	EN-AW 3003 / AlMn1Cu	46 HBW	min. 145, max. 185	125	2.0-5.0	....	German/European standard covering H14 - Strain-hardened - 1/2 hard 3003 aluminum. Mechanical Properties vary with Thickness of plate. Equivalent to the 3003-H14.
	Japan	JIS H 4000:2014	Aluminium and aluminium alloy sheets, strips and plates	A3003P / 3003-H14	0.6	0.7	0.05-0.2	1.0-1.5	...	...	0.1	...	0.05 (Single), 0.15 (Total)	Bal.	A3003P / 3003-H14		min. 140, max. 180	115	1.0-8.0	...	For Plate, Coil & Circular. Elongation varies with thickness. Equivalent to the 3003-H14 standards presented
	China	GB/T 3190-2008 (Chemical) & GB/T 3880.2 (Mechanical)	Wrought Aluminium and Aluminium Alloy – Chemical Composition	3003-H14	0.6	0.7	0.05-0.2	1.0-1.5	...	...	0.1	...	0.05 (Single), 0.15 (Total)	Bal.	3003-H14	...	min. 140, max. 180	115	1.0-5.0	...	This Chinese standard covers wrought aluminum chemical and mechanical properties of equivalent 3003-H14 steel.
ATS Material Aluminum					Chemical Composition Weight Percent											Mechanical Properties					
	Country	Standard	Standard Specification	Grade/ Temper	Si	Fe	Cu	Mn	Mg	Cr	Zn	Ti	Other Elements	Al	Grade/ Temper	Hardness (Rockwell) max.	Ultimate Tensile Strength (Mpa)	Yield Strength (Mpa)	Percent Elongation	Impact Toughness (Joules)	Additional Notes
MIC-6	USA	Alcoa (Proprietary)	...	MIC-6	0.05-0.15	0.26-1.0	1.7-3.0	0.09-0.50	0.9-1.90	...	1.80-5.30	...	...	Bal.	MIC-6	65 HB	166	105	3	...	MIC-6 is a proprietary cast aluminum product from Alcoa, an American aluminum producer. Based of a 7000 series base alloy

- Polymers

ATS Material Polymer					Chemistry	Mechanical Properties					Additional Notes
	Country	Standard	Standard Specification	Equivalent Names	Chemical Name	Density (g/cm^3)	Ultimate Tensile Strength (Mpa)	Yield Strength (Mpa)	Percent Elongation at Yield(%)	Notched Izod Impact (kJ/m^2)	
ACETAL	USA	ASTM D6778 - 14	Standard Classification System and Basis for Specification for Polyoxymethylene Molding and Extrusion Materials (POM)	POM	Polyoxymethylene	1.3 - 1.7	35 - 125	22 -120	1.4 - 25	2 - 50	The mechanical properties vary based on the form and density of the polymer. As the density increases, the strength increases.The properties can continue to vary greatly based on filler metals that can be used with acetal.
		ASTM D6100 - 11	Standard Specification for Extruded, Compression Molded and Injection Molded Polyoxymethylene Shapes		Polyoxymethylene		38-62		5 - 25		

ATS Material Polymer					Chemistry	Mechanical Properties					
	Country	Chemical Name	Standard Specification	Equivalent Names	Chemical Name	Density (g/cm^3)	Ultimate Tensile Strength (Mpa)	Yield Strength (Mpa)	Percent Elongation at Yield(%)	Notched Izod Impact (kJ/m^2)	Additional Notes
UHMW	USA	ASTM D4020-11	Standard Specification for Ultra-High-Molecular-Weight Polyethylene Molding and Extrusion Materials	UHMW-PE	Ultra-high-molecular-weight polyethylene						The mechanical properties vary based on the form and density of the polymer. As the density increases, the strength increases.The properties can continue to vary greatly based on filler metals that can be used with acetal.
		ASTM D6712-01	Standard Specification for Ultra-High-Molecular-Weight Polyethylene Solid Plastic Shapes				21.4	0.13 - 40		30 - 37	
ATS Material Polymer					Chemistry	Mechanical Properties					
	Country	Chemical Name	Standard Specification	Equivalent Names	Chemical Name	Density (g/cm^3)	Ultimate Tensile Strength (Mpa)	Yield Strength (Mpa)	Percent Elongation at Yield(%)	Notched Izod Impact (kJ/m^2)	Additional Notes
PEEK	USA	ASTM D8033 - 16	Standard Classification System for Poly(Ether Ketone) (PEEK) Molding and Extrusion Materials		Polyether ether ketone		54.5 - 150	65 - 115	4.5 - 45		