

BRMS Near Net Shape Program

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Part 1- BRMS Near Net Shape Program

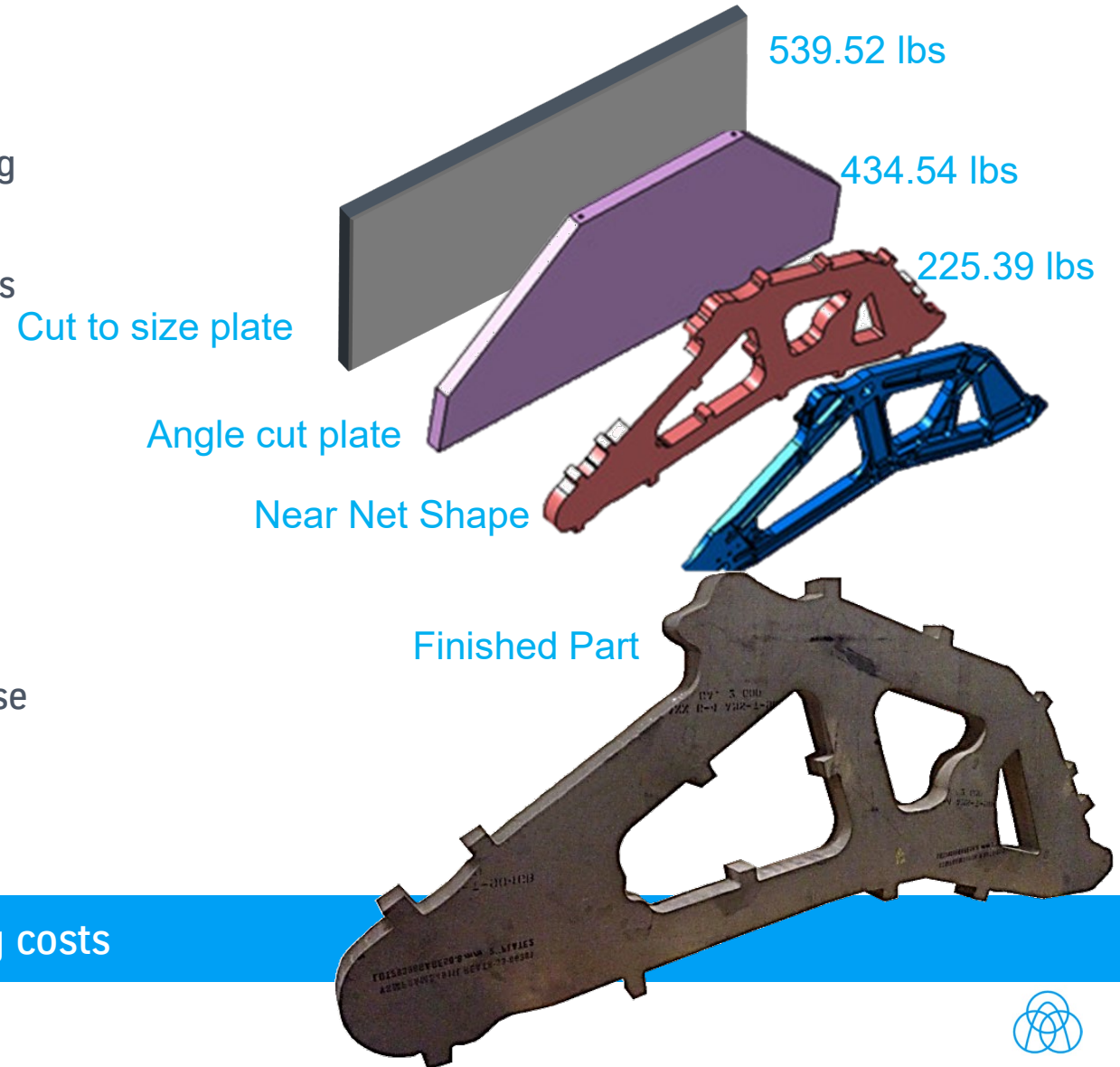
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Boeing Raw Material Strategy (BRMS) Near Net Shape Program

The Perfect Example:
Boeing Portland savings of
\$57,000 per shipset

- The Near Net Shape (NNS) program was established in 2010 exclusively for the Boeing supply base
- TMX cuts Near Net Shapes from aluminum and titanium plates using waterjet CNC machines in Auburn WA and Wichita KS
- A Near Net Shape refers to raw material that more closely resembles the complicated shape of the finished part
- This program provides further productivity and metal utilization savings to the BRMS participants
- Savings millions of dollars to date, the NNS program is just one of many ways Boeing suppliers can cut their costs within the BRMS
- Working together, our NNS team will assist Boeing suppliers in the selection of proper part NNS candidates. By carefully selecting these part candidates, our program will be able to provide the maximum savings to BRMS participants



Near Net Shapes (NNS) reduce material weight and machining costs



A great example: Boeing Portland

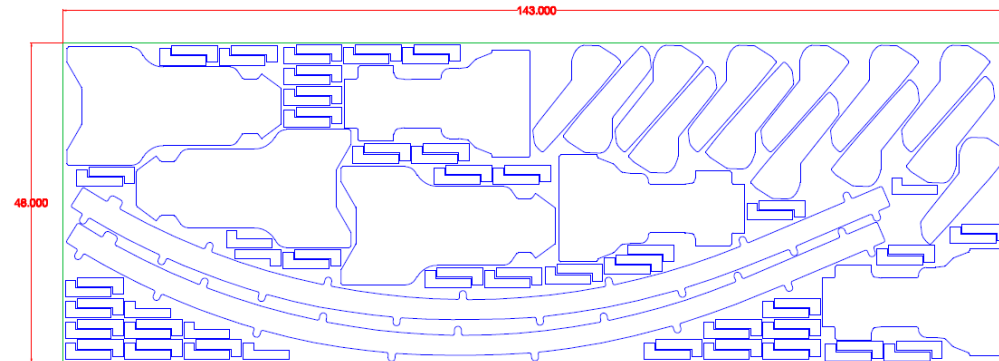
- Boeing Portland was one of the first cases within the BMRS NNS program
- By shifting this work to TMX and purchasing water jetted NNS's, Boeing saved approximately \$57,000 per shipset for 747 program. Included in the savings was raw material costs and productivity gains.
 - Boeing Portland saved 40 hours machining the initial 16 parts (8 pairs) and further saved more than 100 hours of roughing time per shipset
 - It was estimated about 55 percent less material into Boeing's manufacturing stream for these 747-8 parts
- This process also created a byproduct of titanium remnant pieces, which can be further used by other BRMS participants, rather than scrapped at the customer location.



How are the savings engineered?

Material Cost Reduction	The NNS is produced per the supplier's design and suits their manufacturing requirements.
VAS Fee Reduction:	TMX will assist in the design process to achieve the most economical design. We have engineers on staff to assist in this process
Scrap Cost Reduction	The NNS may be nested with other NNS to maximize material utilization and reduce Boeing's total supply chain metal usage / costs

- An RMUA (Raw Material Utilization Adder) is calculated by Boeing and added to the cost of the NNS charged to the supplier. This RMUA is meant to financially recognize the scrap produced during the NNS cutting process.
- The RMUA is reduced or eliminated when the supplier agrees to lower the cost of the finished part to Boeing



Material Cost	RMUA Fee	VAS Fee	Total Cost Per NNS
\$ 2,407.21	\$ 2,905.33	\$ 719.06	\$ 6,031.60



Meet your TMX Near Net Shape team



**Dave
Smith**

Director

VAS Sales

32 Years aerospace supply
chain experience

Dave.smith@thyssenkrupp-materials.com
253-243-4522



**Edgar
Bothi**

NNS Engineer

10 years design engineering
experience

Edgar.bothi@thyssenkrupp-materials.com



**Brian
Gallagher**

NNS Analyst/Estimator

12 years NNS account management and
customer service experience

Brian.gallagher@thyssenkrupp-materials.com
253-653-1604

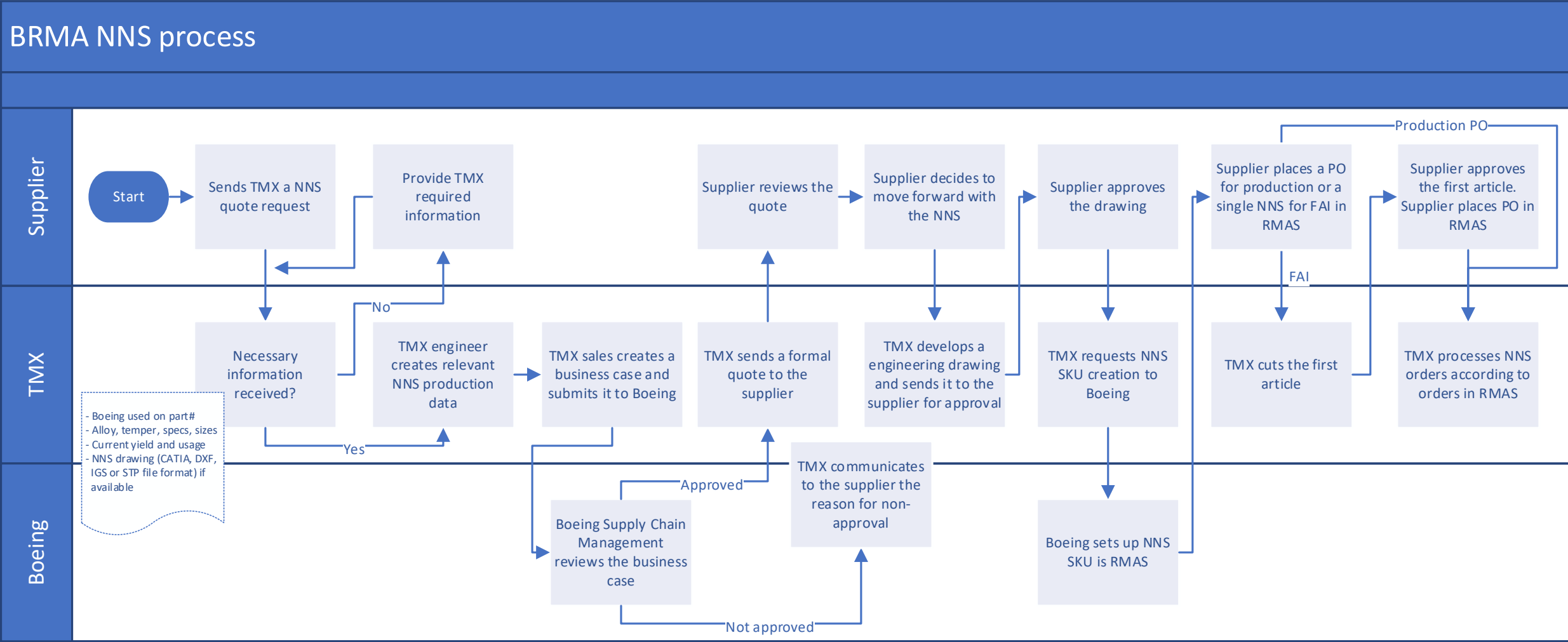


Part 2- NNS Quotation to Production Process

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Quotation to production flowchart



RFQ is received

Supplier submits the following information to TMX NNS team

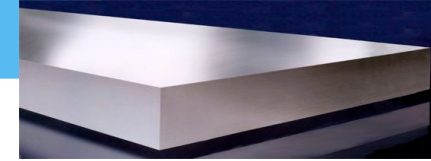
Boeing used on part number

Example: 487**A**1234-7

- Detail part number as listed on your SOW

Raw material requirements

- gauge, alloy, temper, specifications



“As-Is” material data or “as is” NNS data

- Tier 1 supplier, current material usage & yield

NNS drawing if available

- Files types: CATIA, DXF, IGS, STP



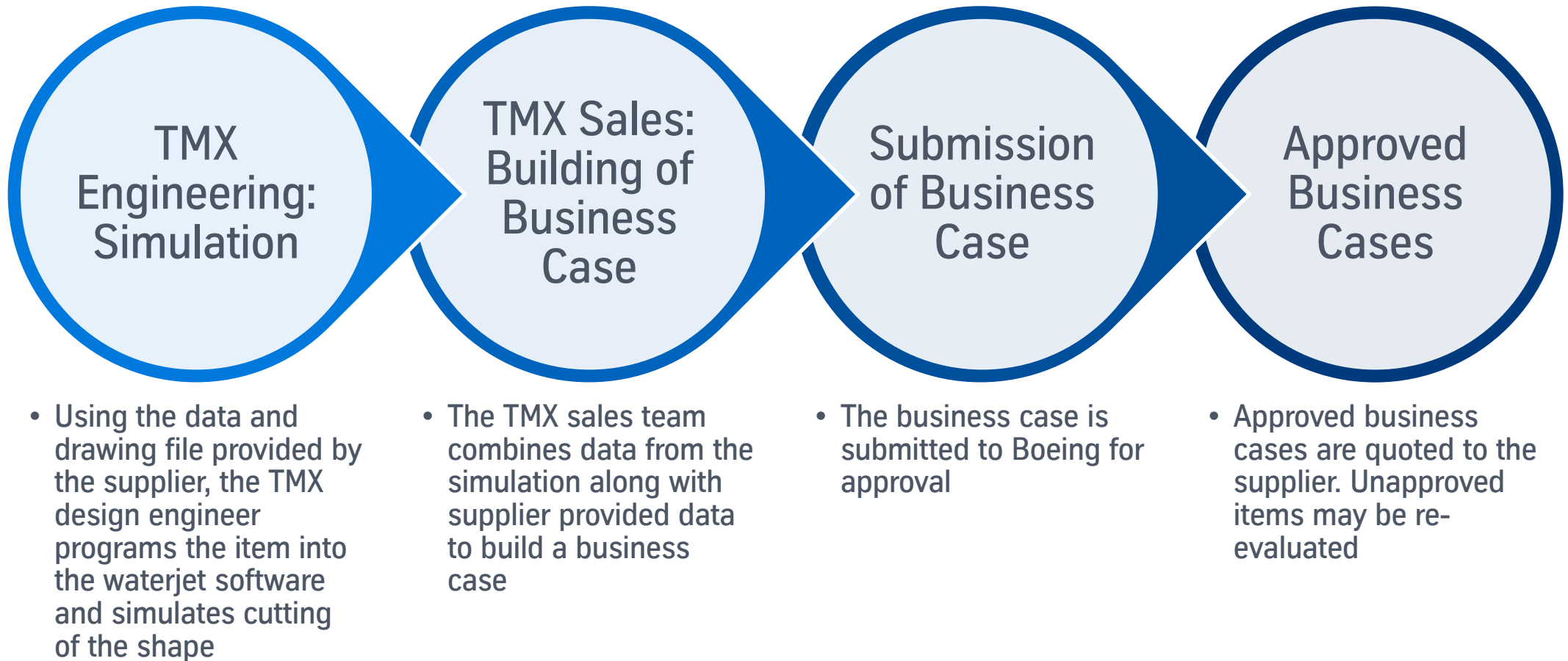
NNS drawing Details

- offset and grain direction



Business case approval

Business case is created, then approved by Boeing



Quotation

After business case is approved, quotation is sent to the supplier

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NNS Quote

Stock material is subject to prior sale. Lead-time is subject to change; actual schedule is determined at the time of order entry and after customer approval of engineering drawings, templates, and first articles. TMX does not guarantee flatness after waterjet cutting. When placing your order, please reference this quote and the Boeing used on part #. Pricing is valid for Boeing Commercial Airplane applications only, at the quantities quoted and for a maximum period of 6 months from the date of this quote.


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Item #	Airplane Part No.	Quoted Qty (per delivery)	tkA Part No.	Material Specification	Material Thickness	Profile Tolerance	Draft Allowance	Edge Condition	Material Cost	RMUA Fee	VAS Fee	Total Cost Per NNS	Customer Drawing
1	487A1234-7	2	N/A	5.25 7050 T7451 Per BMS 7-323 Type 1	5.250	1.800	0.088	2.0	\$464.99	\$315.73	\$390.44	\$1,171.15	Boeing Published Lead Time Plus 4 week for the NNS
2													
3													
4													
5													
6													
7													
8													
9													
10													

The INCOTERMS 2000 for all orders from Buyer will be Free on Board (FOB) if by ocean and Delivery Duty Unpaid (DDU) otherwise; Boeing will pay for freight per Boeing's standard routing instructions. When Buyer's order requests delivery outside the United States of America, the Importer of Record will be the Buyer placing the order. Title and risk of loss shall pass at place of shipment (i.e. for orders shipped directly from a mill, title and risk of loss shall pass when Boeing, or its designee, assume control of the Material; for orders shipped from Boeing, or Boeing's service provider, title and risk of loss shall pass at Boeing, or Boeing's service provider's, shipping dock and Buyer will maintain adequate insurance to cover shipments at the time title and risk of loss transfer to Buyer).

The exclusive terms and conditions applicable to any Order issued by Buyer and accepted on behalf of The Boeing Company shall be those terms and conditions contained in the Boeing Raw Material Participation Agreement, or other applicable agreement between Buyer and Boeing, together with all amendments, attachments, and exhibits thereto (the "Agreement"). Any and all Buyer term(s) and/or condition(s) that conflict with, add to, or take away from the terms and conditions of the Agreement are specifically rejected and shall be null and void and of no force or effect. Buyer's issuance of an Order, acceptance of an acknowledgement of an Order, or acceptance of delivery or partial delivery of any Order shall conclusively evidence Buyer's acceptance of the conditions of this paragraph.

Quoted By:

Dave Smith

Title:

VAS Director

Date:

xx/xx/xxxx

Customer:

Supplier X

RFQ#:

487A1234-7 NNS

Attention to:

John Doe

Buyer Signature:

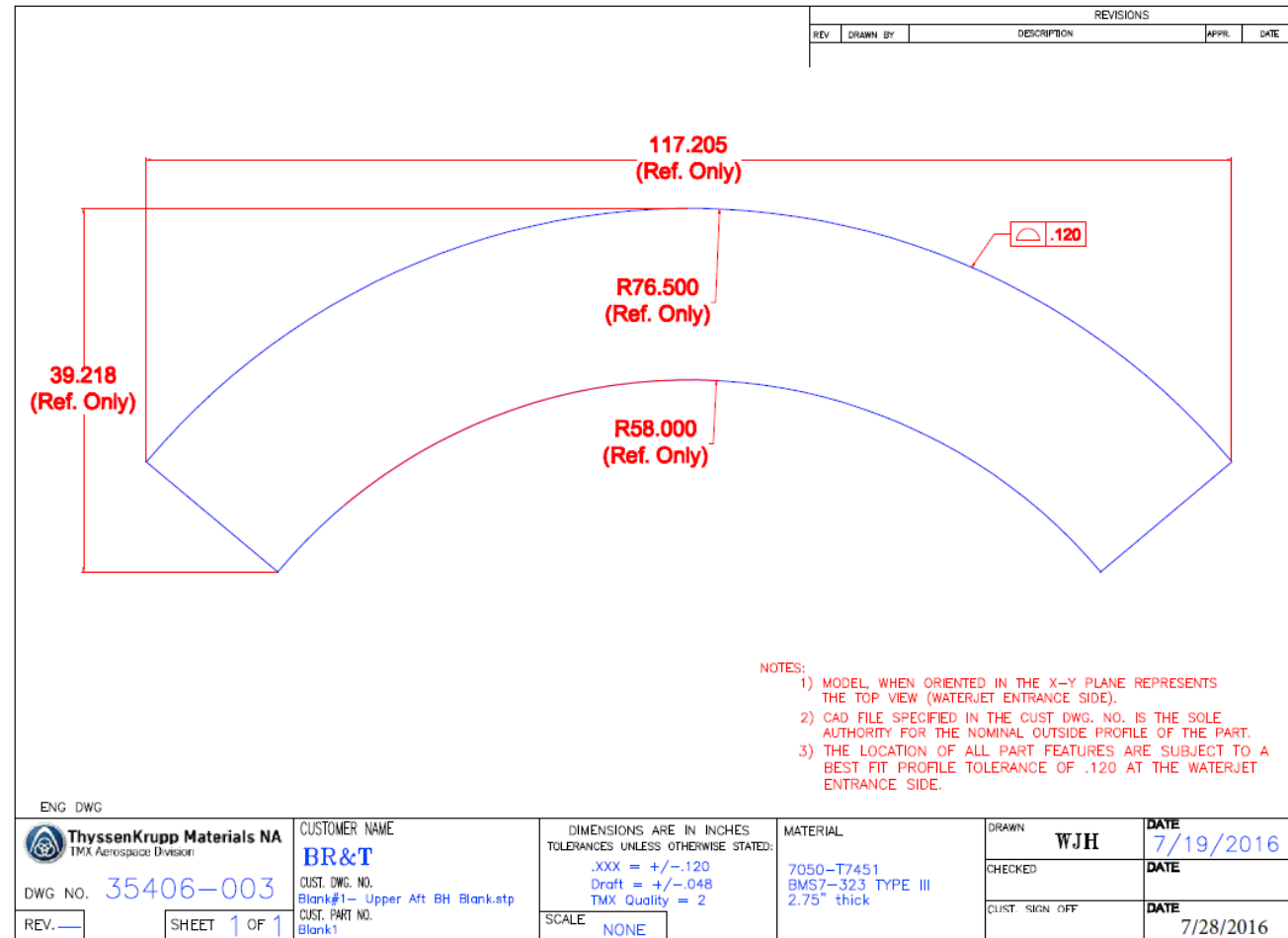
John Doe

Date:

xx/xx/xxxx

Drawing approval

1. Supplier decides to move forward with the NNS!
2. TMX design engineering will develop an engineering drawing which provides the following detailed information:
 - NNS dimensions
 - Tolerances
 - Edge condition(s)
 - Material (gauge, alloy, temper, specifications)
 - Grain direction (where required)
 - Supplier & Boeing part numbers
 - Traceability to Supplier CAD drawing(s)
 - TMX internal references (for AS9100 compliance)
3. The supplier is asked to approve the engineering drawing to verify all data is correct



FAI – First article inspection when requested (recommended)

Prior to entering full production of a NNS, TMX recommends the FAI process be utilized to prevent large finished good rejections

- After drawing is approved by the supplier, the supplier places a purchase order for a single NNS for FAI
- TMX produces the first article according to the approved drawing and supplier purchase order
- The supplier may visit the waterjet facility for a source inspection, or the shape can be sent to the supplier for inspection and approval
- FAIR documents are kept at TMX per AS9100



Form 1: Part Number Accountability			
Sheet 1 of 3			
1. Part Number 21225115-2002 NNS	2. Part Name 21225115-2002 NNS	3. Serial Number	4. FAI Report Number QF7039
5. Part Revision Level	6. Drawing Number 35406-002	7. Drawing revision level	8. Additional Charges
9. Manufacturing Process Reference	10. Organization Name ThyssenKrupp Aerospace	11. Supplier Code	12. P.D. Number 1161620
13. Detail FAI Accountable FAI	14. Signature Part Number including revision level		

Form 3: Characteristic Accountability, Verification and Compatibility Evaluation													
Sheet 3 of 3													
1. Part Number 21225115-2002 NNS				2. Part Name 21225115-2002 NNS				3. Serial Number		4. FAI Report QF7039			
5. Characteristic Accountability													
5. Char no	6. Reference Location	7. Characteristic Designator	8. Requirement	9. Results	10. Inspection / Test Result		11. Non-Conformance Number	14. (Insert columns, etc. as required by Organization or Customer)					
A			1/-180 7.500	7.523/7.516	CALIBER								
B			1/-180 57.060	57.030/57.010	THREE								
C			1/-180 3.750	3.725/3.652	CALIBER								
12. Prepared By: <i>Shawn Wight</i>													

Form 2: Product Accountability -- Raw Material, Specifications and Special Process(es), Functional Tosting									
Sheet 2 of 3									
1. Part Number 21225115-2002 NNS		2. Part Name 21225115-2002 NNS		3. Serial Number		4. FAI Report Number QF7039			
5. Material or Process Name 7050-T7451 T1		6. Specification Number AMS7-323		7. Code ALUMINUM PLATE		8. Special Process Supplier Code CONSTELL		9. Customer Approval Verification (Qualification) YES	
10. Certificate of H/L Conformance number 9318756									
11. Functional Test Procedure Number									
12. Acceptance report number, if applicable									
13. Comment									
14. Prepared By: <i>Shawn Wight</i>									
15. Date: 10/28/15									



Production



- After the FAI process, a NNS will enter full production according to the supplier's production schedule and purchase orders placed in RMAS
- Quality controls include:
 - proprietary pre-cutting inspection
 - in-process inspection
 - post-production inspection



Part 3- NNS in more detail

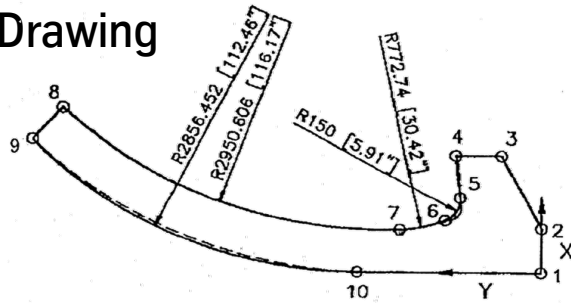
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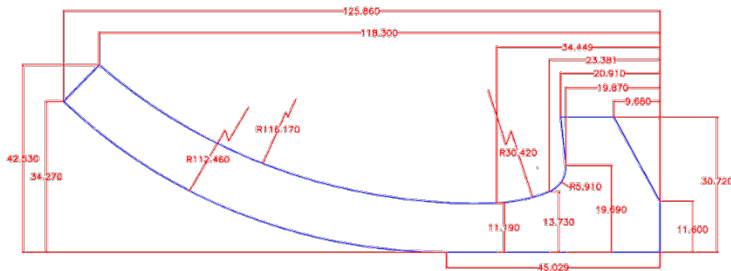
NNS example- B747 wild body upper lobe edge frame

4) NNS in production

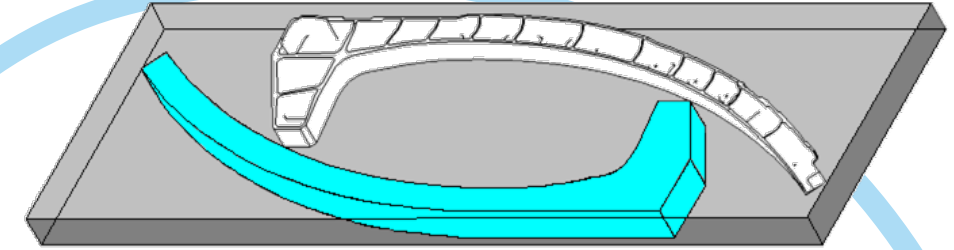
1) Customer Drawing



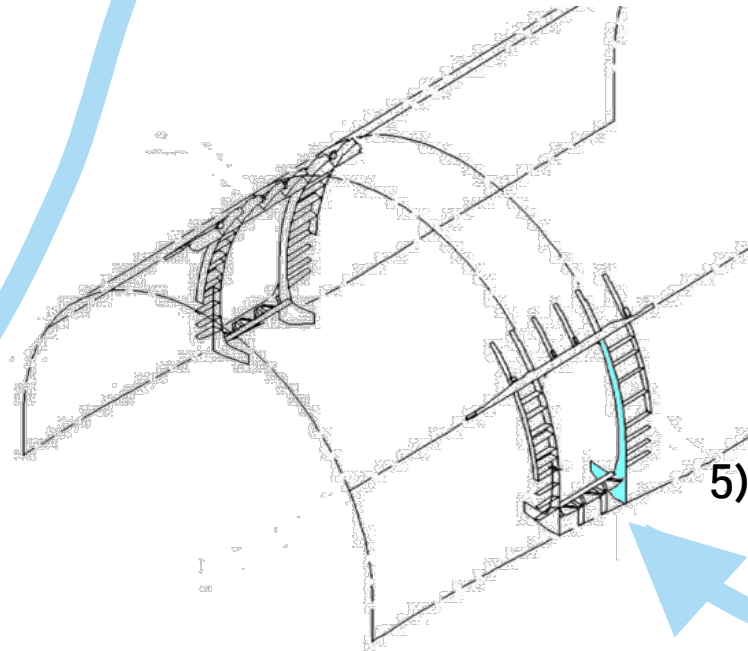
2) Engineering Drawing



3) First Article



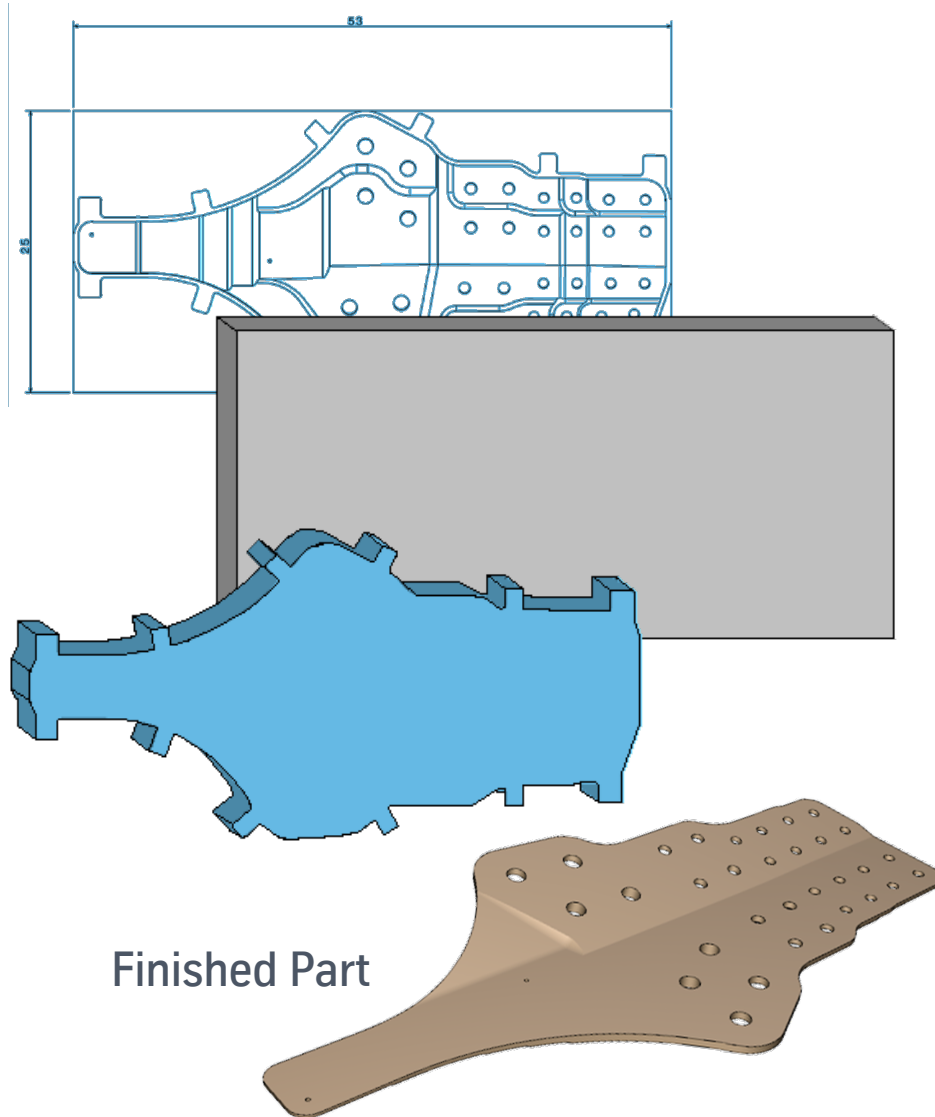
4) Part is made



5) Part on aircraft



NNS example- 3.75" thick 6Al-4V aircraft part



QUANTITY	DESCRIPTION	UNIT PRICE	TOTAL	DELIVERY DATE
12.00 PC	BOEING 6-4 TI PLATE 827837 - 3.75 SAW 30.5" (+.125,-0) X 71" (+.125,-0) Grain to run parallel with the 71" dimension. Cust PO Item: 1. Boeing Used On: Plane Major No: Cust PO No: ' Cust PART No: ' Test Results Attn to: QA Department. Export pack per 8.2.4-4-545.ISPM Stamp for wood.Only same prefix can be packed together. Linemark for all cut pcs.6-4 PER AMS4911 ANN PLATE AMS-T-9046 SUPSED BY, AMS 4911	18,448.67 PC	\$221,384.06	06/06/2011
15,637.30 LB				

Originally 3.75" x30.5" x71" rectangular piece

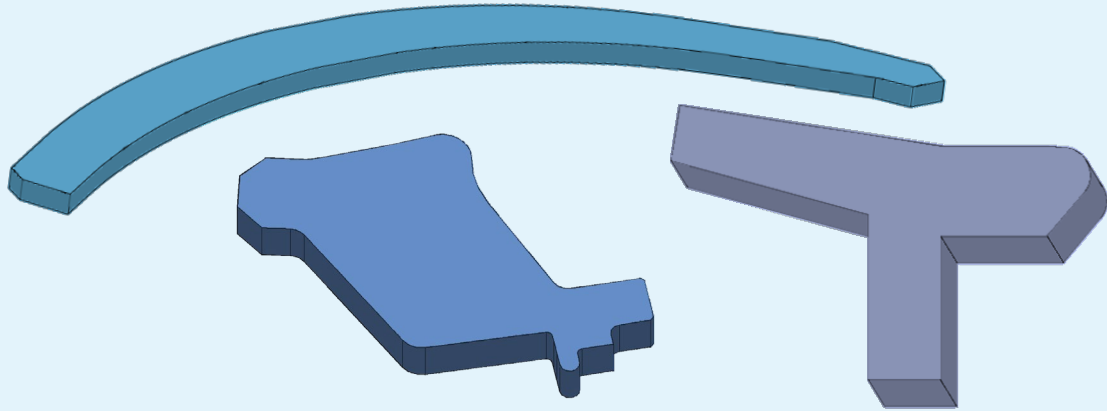
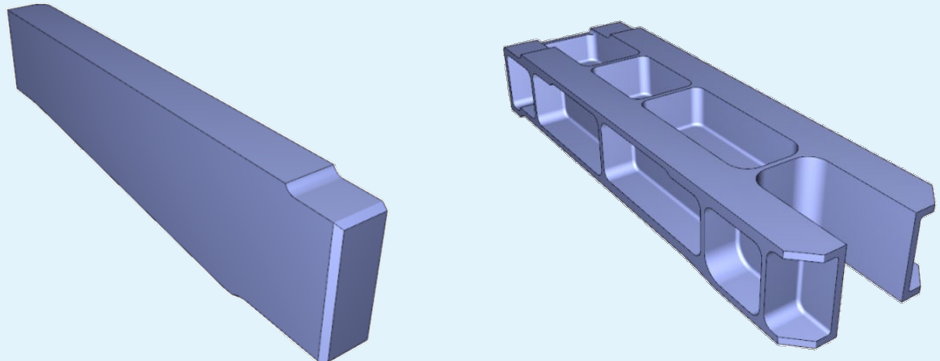
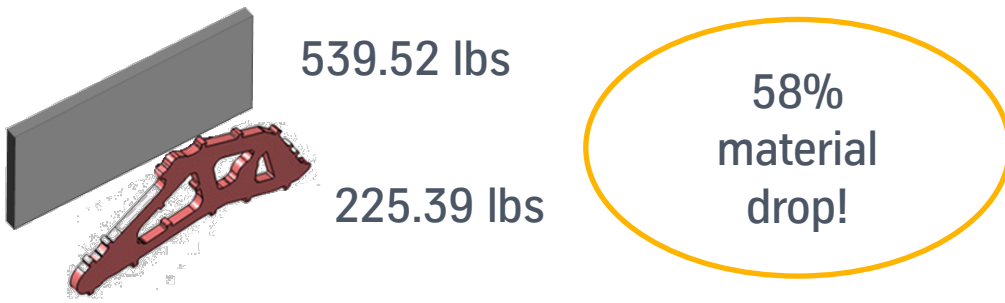
1,303 lbs

Material	\$17,930.38
Cutting	\$518.29
Total	\$18,448.67

Cost of NNS:				
	Description	\$/lb	NNS Weight	\$/PC
Material:	3.75" thick 6AL-4V Plater Per AMS4911	\$13.14	488.00	\$6,412.32
VAS:	Cutting of the ' near net shape at edge quality 2 to a profile tolerance of +/-0.120" with a draft allowance of +/- 0.064". All radii minimum R0.50			\$1,342.21
Unit Cost:	Combined cost of metal and VAS			\$7,754.53

488 lbs

Near Net Shape candidate and non-candidate shapes

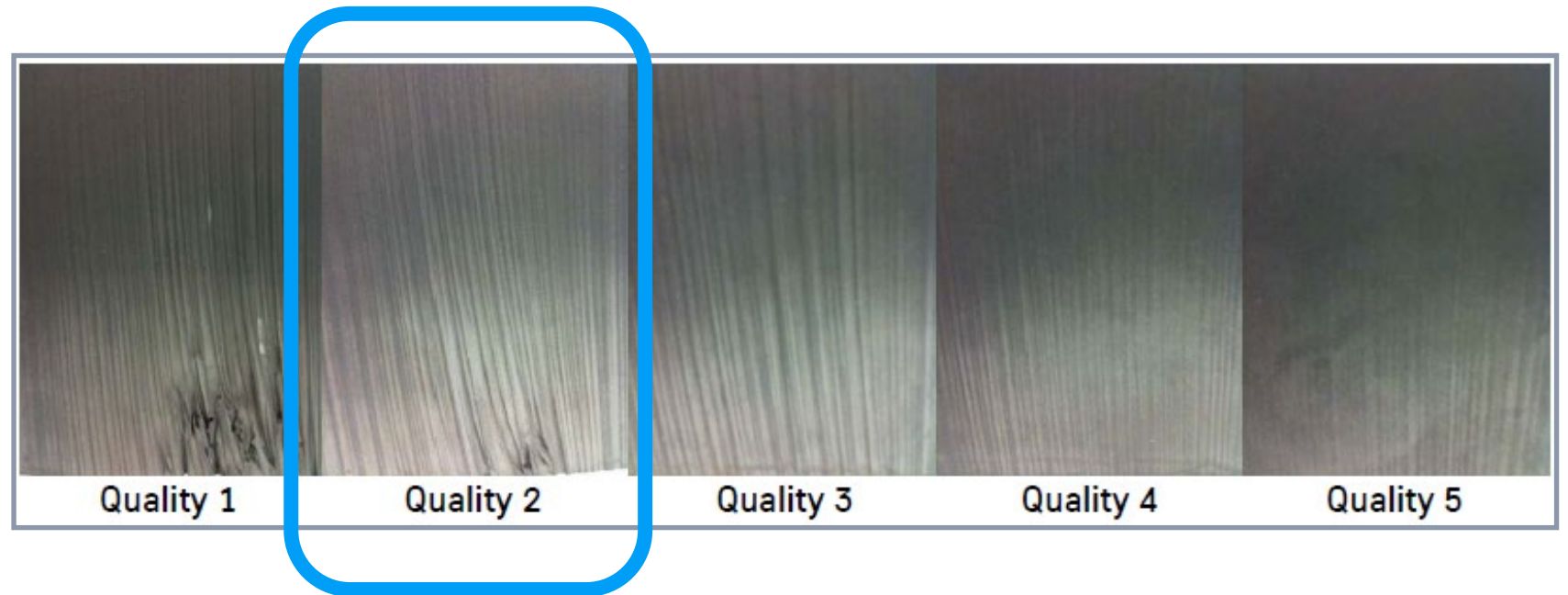
Good candidate	Non-candidate
	
The best candidate shapes are those with 25% or more material drops from the engineering envelope (minimum sized plate to yield a single part)  539.52 lbs 225.39 lbs 58% material drop!	Finish part shape is more liner shape without much material drop (25% or less) from the original plate size



Edge condition choices

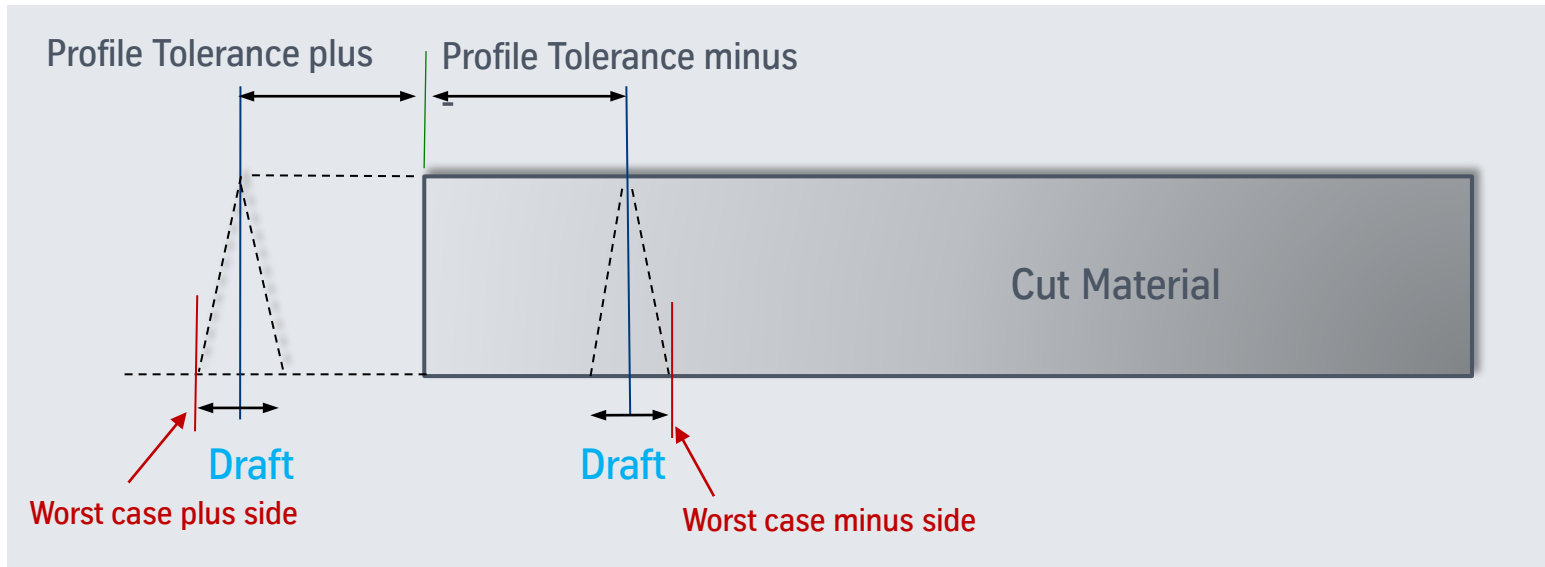
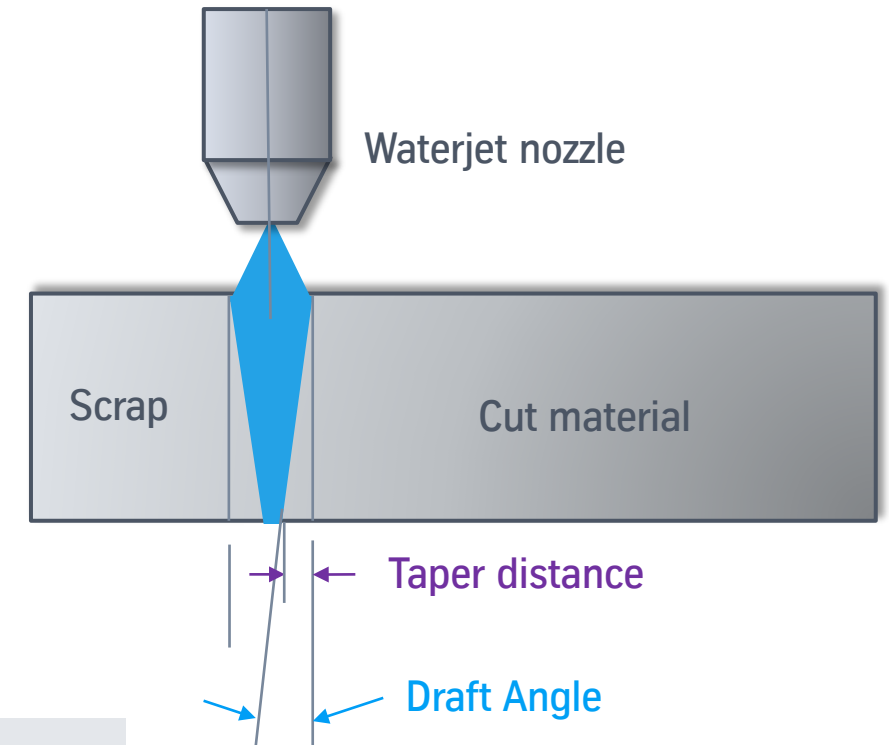


- TMX standard edge condition is Quality 2
- Lower the number, rougher the edge condition. Higher the number, smoother the edge but takes longer to cut so more costly



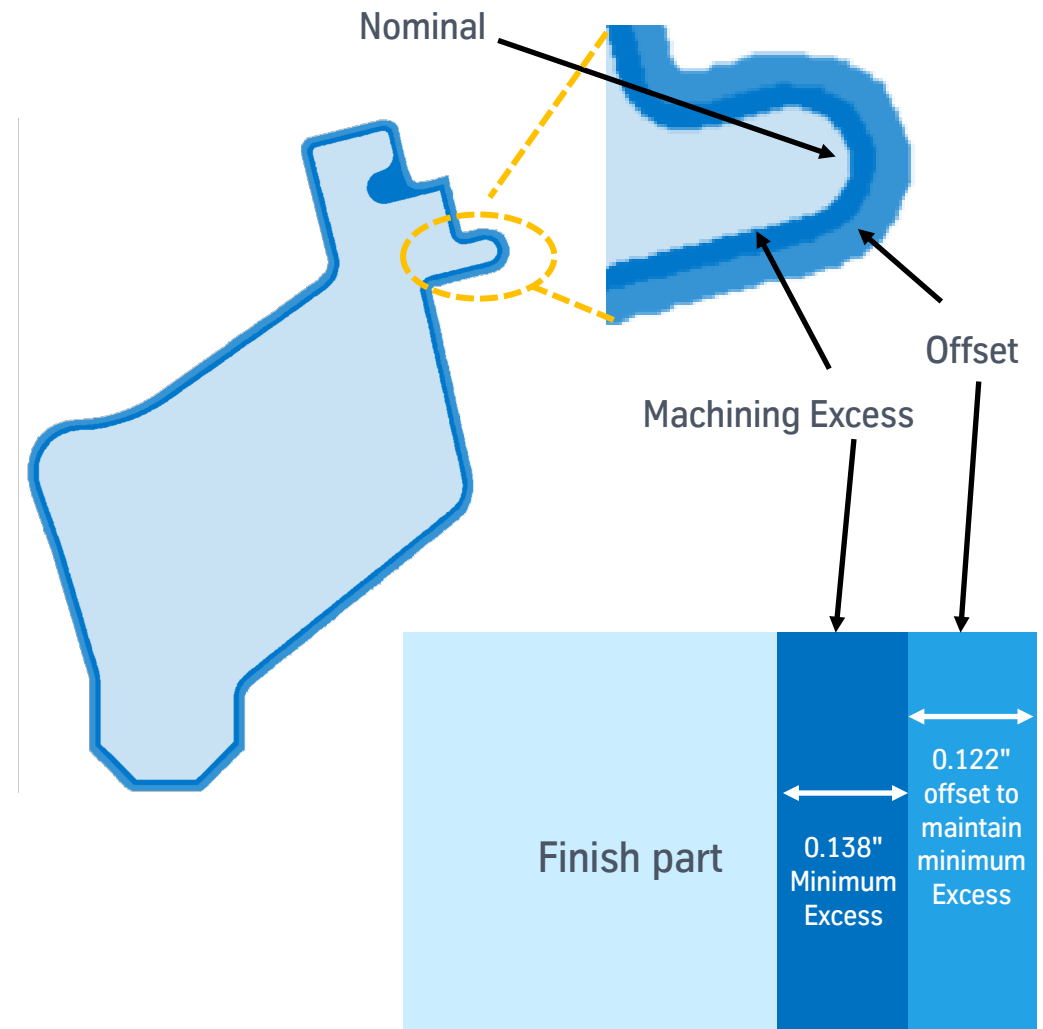
Draft

- A waterjet propels water and garnet through a nozzle initially with high pressure, but it loses energy as the stream cuts the material
- This causes a V-shaped taper, called a **draft angle**
- **Draft** strays away from the NNS on straight cuts
- **Draft** can stray away from or into the NNS at radiuses depending on speed and direction



Tolerances

- NNS tolerances should consider both profile tolerance and draft allowance
- For example, a supplier needs 0.138" excess from nominal on their 2.00" thick NNS. The supplier will need to offset their NNS by adding a minimum of .122" (a profile tolerance $\pm .090$ " plus a draft allowance $\pm .032$)
- Adding both customer's .138" excess requirement and waterjet minimum tolerance of .122", the water jet will be programmed to cut .26" away from the finish part, or at least .138" away from it



TMX recommended NNS tolerances

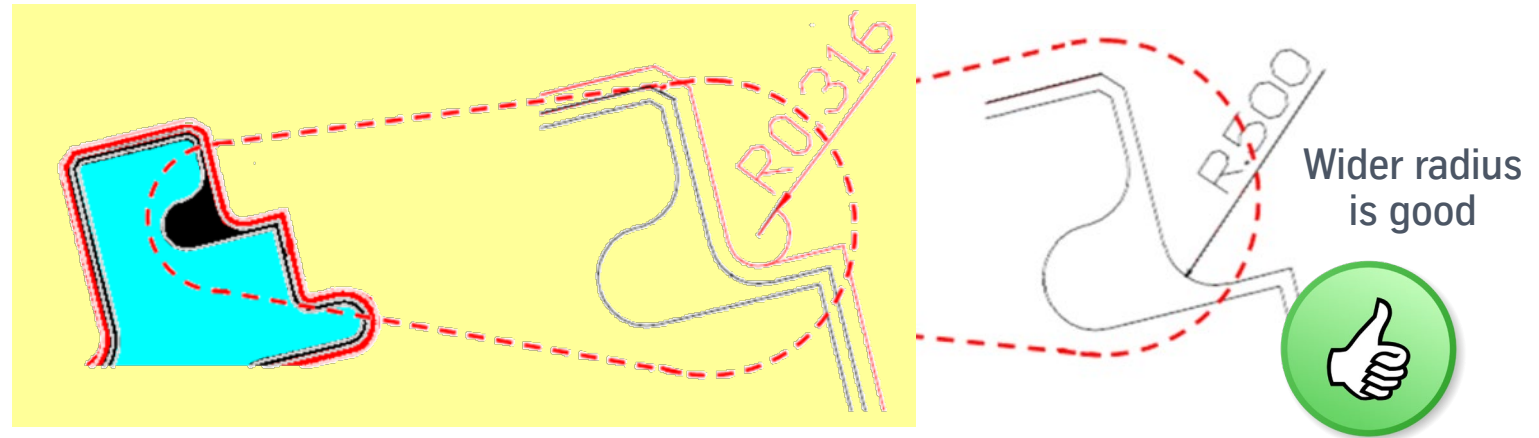
Aluminum				
Thickness in Inches	Recommended + Offset from Net Geometry	Profile Tolerance (Entrance side)	Taper/Draft Allowance +/-	Minimum Radii
0.50	0.150	0.060	0.016	R0.12
1.00	0.200	0.060	0.016	R0.12
1.50	0.200	0.060	0.024	R0.25
2.00	0.200	0.090	0.032	R0.38
2.50	0.200	0.090	0.040	R0.38
3.00	0.200	0.120	0.048	R0.38
3.50	0.200	0.120	0.056	R0.50
4.00	0.200	0.120	0.064	R0.50
4.50	0.250	0.120	0.072	R0.50
5.00	0.250	0.120	0.080	R0.75
5.50	0.250	0.180	0.088	R0.75
6.00	0.375	0.180	0.096	R0.75
6.50	0.450	0.180	0.104	R1.00
7.00	0.450	0.180	0.168	R1.00
7.50	0.450	0.180	0.180	R1.00
8.00	0.550	0.180	0.192	R1.00

Titanium				
Thickness in Inches	Recommended + Offset from Net Geometry	Profile Tolerance (Entrance side)	Taper/Draft Allowance +/-	Minimum Radii
0.50	0.150	0.060	0.016	R0.12
1.00	0.200	0.060	0.016	R0.12
1.50	0.200	0.060	0.024	R0.25
2.00	0.200	0.090	0.032	R0.38
2.50	0.200	0.090	0.040	R0.38
3.00	0.200	0.120	0.048	R0.38
3.50	0.200	0.120	0.056	R0.50
4.00	0.200	0.120	0.064	R0.50
4.50	0.250	0.120	0.072	R0.50
5.00	0.375	0.120	0.080	R0.75
5.50	0.375	0.180	0.088	R0.75
6.00	0.400	0.180	0.096	R0.75



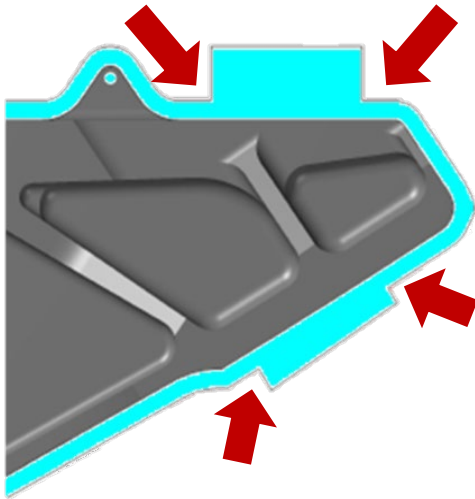
Radius

- TMX recommends wide radiuses
- Wide radiuses reduce cut time and lower risks



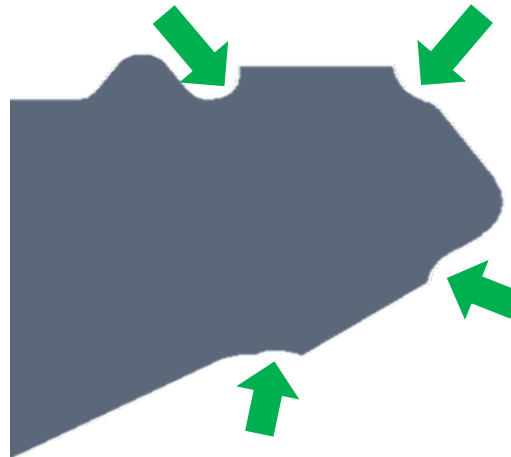
→ Sharp Radius

Slow cut time + high risk = higher cost



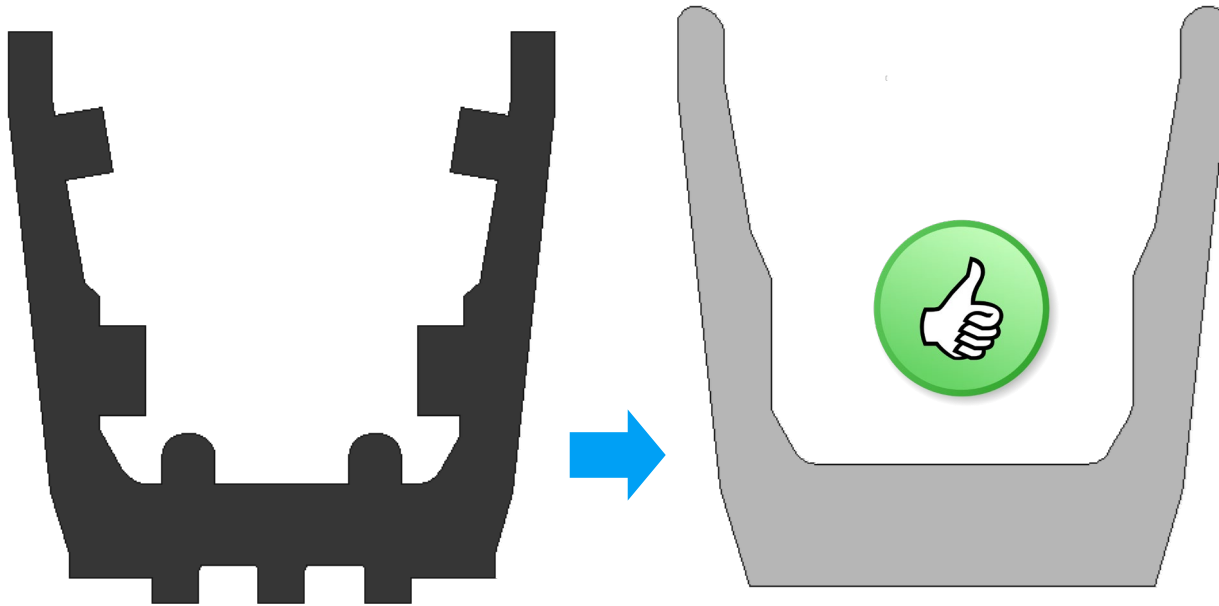
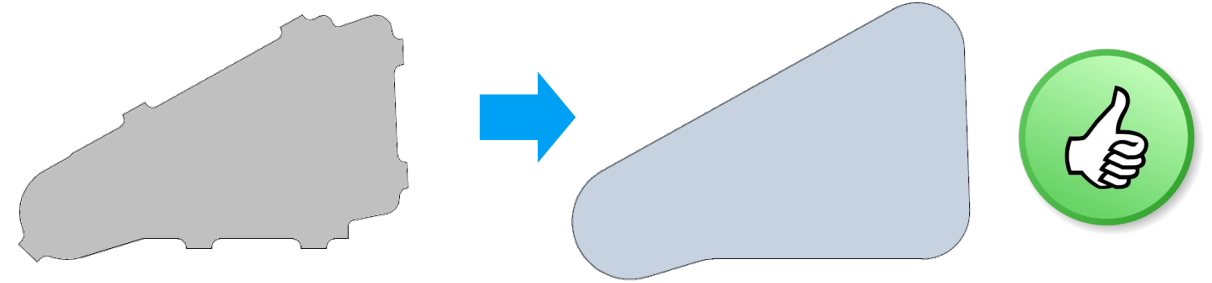
→ Wider Radius

Fast cut time + low risk = lower cost



Tooling tabs

- Fewer tooling tabs lowers cut time and lowers the cost



TMX NNS production capacity

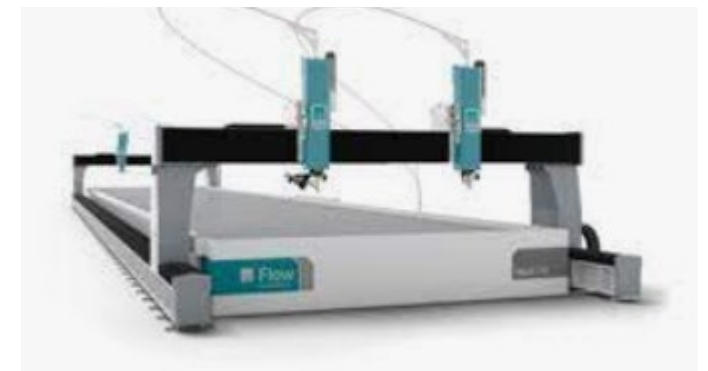
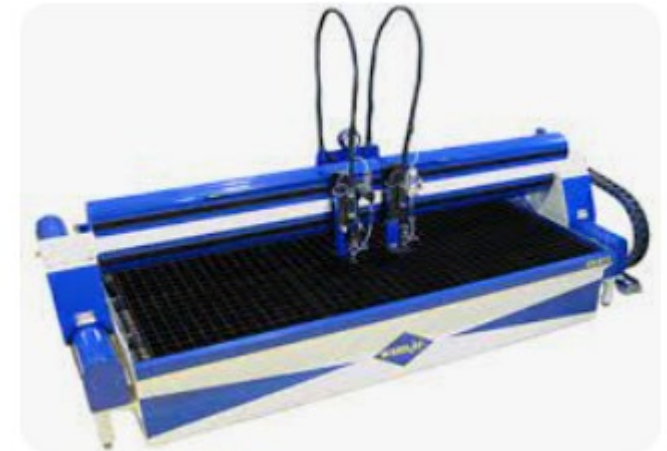
10 waterjets with varying capabilities

- OMAX
- Ward Jet
- Flow

2 Geographical Locations (5 jets each)

- Kansas
- Washington State

TMX Aerospace possesses existing capacity which will handle almost any requirement, urgent or sustaining



Part 4- Setting up NNS parts in RMAS for order management

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Setting up your unique NNS SKU in RMAS – We are here to help!

1. After receiving a signed NNS quote and TMX engineered drawing from the supplier, TMX completes a RMAS NNS SKU request form and sends it to Boeing
2. The Boeing team creates a NNS SKU for the NNS in RMAS (Example : 99999920000001423)
3. TMX contacts the supplier with the new NNS SKU number and correlating SMRM (Example: AGGMA006W-068) for the base material.
4. The supplier now can add the new NNS SKU with the base material SMRM to their SOW in RMAS

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NNS Quote

Blank material is subject to prior sale. Lead-time is subject to change, actual schedule is determined at the time of order entry and after customer approval of engineering drawings, templates, and first articles. All drawings and quantities subject to change after customer approval. When placing your order, please reference this quote and the Aerospace part no. This quote is valid for a maximum period of 6 months from the date of this quote. Thyssenkrupp Terms and conditions can be found at: <http://www.thyssenkrupp-aerospace.com/termsandconditions>.

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Item #	Airplane Part No.	Quoted Qty (per delivery)	QA Part No.	Material Specification	Material Thickness	Profile Tolerance	Drift Allowance	Edge Condition	Material Cost	Setup Fee	VAS Fee	Service Fee	Total Cost Per NNS	Lead Time
1	487A1234-7	2	N/A	6.6 T060 T7461 per BMS 7-323 Ty I	6.600	0.180	0.008	2.0	\$464.00	\$316.73	\$300.44		\$1,171.16	Being Fabricated Lead Time Plus 4 week for the NNS
2														
3														
4														
5														

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Quoted By: Dave Smith

Customer: Supplier X

By: VAS Director

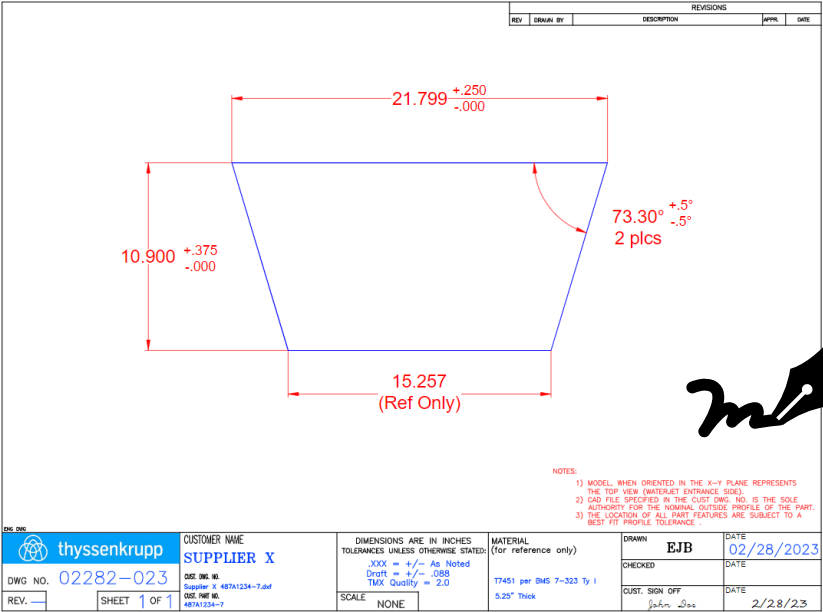
RFQ#: NNS For the 487A1234-7

Date: XX/XX/XX

Attention to: supplier@supplier.com

Buyer Signature: 

Date:



Enter an order using NNS SKU number in RMAS – We are here to help!

4. Once the NNS SKU has been added to the SOW, the supplier can place a PO in RMAS (HYBRIS) for the NNS using the NNS SKU from the SKU drop down
5. If the supplier has issue adding to their SOW, please contact the TMX SOW support Team at sowsupport@thyssenkrupp-materials.com

PLACE ORDER REQUEST

Specify a material below, or [upload a bulk order](#) or [bulk quote](#) request.

Other Ways to Place Order

[Upload Bulk Order Request](#)

Material Form Tips

This is a form that updates automatically as you enter your material criteria.

TERMS

- » AOG: "Aircraft on ground"
- » On Dock Date: The date an item is required to be delivered and available on the delivery dock.
- » PVC is not offered on cross dock plate orders, and most mill direct orders. If you select this as an option, your order is subject to rejection or delays.

Material Specifications

Product Search

Product Search

[Look Up SOW](#)

OR

Material Type *

SKU

Product Name *

999999200000000866



Thank you

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