BAJA SAE® 2023 Roll Cage Documentation Package

Instructions

On the following pages, insert the following information as a screenshot, photo, or scanned image. Add as many pages are necessary; making certain that your information is ***CLEAR and READABLE***!

Log on to www.bajasae.net and click My Team Document Submissions. There will be a slot for "Frame Design Pre-Check- Roll Cage Documentation" for each competition. If your frame will not (and does not) change between competitions, you may upload this exact same document for each competition. If your design changes significantly, you should submit an updated document. The National Tech Inspector frame specialists will review your submission and mark it as "Accepted" or "Rejected" on CdsWeb. Questions or feedback will be provided for rejected submissions.

Rules Reference:

B.3.7 - Roll Cage Documentation Package

B.3.7.1 - Required Documents

Required documents for the Roll Cage Documentation Package include: Roll Cage Specification Sheet & material documentation (invoices, certifications, calculations, etc.) and a single isometric view diagram of the frame highlighting professional fabrication.

B.3.7.2 - Document Submittal

1) Download the form and template from bajasae.net download section (Note: All files that are uploaded must be in a PDF format)
2) Upload the Roll Cage Documentation Package (max size 5 MB)
    a. Roll Cage Specification Sheet
    b. Invoice of roll cage material
    c. Material Test of Certification
    d. Any Required Calculation per rule B.3.2.16 - Roll Cage Materials
    e. A diagram highlighting any parts of the frame that were outsourced or professionally fabricated

B.3.7.3 - Process

Documents will be reviewed by the National Technical Inspectors on a first come first serve basis. Typical review period will be 30 days after submittal. After review, feedback will be given to teams. If the submission is rejected by the National Technical Inspectors, the team must correct the error noted in the rejection and continue to resubmit the Roll Cage Documentation Package, until they are marked Accepted. It is the responsibility of teams to submit complete documents by the appropriate deadlines. If teams have additional questions, they will need to use other resources to find the answers or wait until competition.

Note: If a team's initial Roll Cage Documentation Package is received more than five (5) days late it will be classified as "Not Submitted" and your team will be removed (withdrawn) from the event. Documents do not need to receive a Pass Judgement in order to satisfy this requirement.

BAJA SAE ROLL CAGE SPECIFICATION SHEET
2023 BAJA SAE COMPETITIONS

SCHOOL NAME Northern Arizona University **CAR NUMBER** 74

The competition in which you are competing: BAJA SAE Oregon

This sheet MUST be completed and submitted in accordance with the competition rules. Failure to do so will result in penalty.

Purpose: The purpose of this sheet is to facilitate verification of roll cage materials/construction, and to provide a means of tracking the age of older vehicles. This is being done in the interest of good engineering practice and confirming the fabrication techniques of the team.

1.Academic year the cage was constructed? 2022-2023

2.Material Type (i.e.: 4130): 4130 OD: 1.25in Thickness: .065in

3.Primary Welder: Henry Van Zuyle Welding Method used: GTAW

Type of Filler Material: ER80S-D2 Shielding Gas Used: 100% Argon

4.Equivalency calculations if needed (attach to this sheet).

5.All welds and/or other attachment methods must be checked for integrity. Faculty advisor and team captain are required to do destructive testing on sample joints that represent the integrity of similar welds on their frame. Testing and inspection must occur before roll cage fabrication is started.

Date of inspection: November, 2022

NOTE: It is extremely important that such an inspection be made to ensure the welds have good penetration and joints are completely welded.

WE HAVE EXAMINED THE ABOVE INFORMATION AND TO THE BEST OF OUR KNOWLEDGE DEEM IT TO BE ACCURATE.

TEAM CAPTAIN: _____ _____
(SIGNATURE) (DATE)

FACULTY ADVISOR: _____ _____
(SIGNATURE) (DATE)

Bring a signed and completed copy of this form with you to technical inspection FOR EACH COMPETION your team is entering.

BAJA SAE ROLL CAGE SPECIFICATION SHEET
2021 BAJA SAE COMPETITIONS

SCHOOL NAME Northern Arizona University **CAR NUMBER** 29

The competition in which you are competing: Baja SAE Tennessee

This sheet MUST be completed and submitted in accordance with the competition rules. Failure to do so will result in penalty.

Purpose: The purpose of this sheet is to facilitate verification of roll cage materials/construction, and to provide a means of tracking the age of older vehicles. This is being done in the interest of good engineering practice and confirming the fabrication techniques of the team.

1.Academic year the cage was constructed? 2021-2022

2.Material Type (i.e.: 4130): 4130 OD: 1.25in Thickness: .065 in

3.Primary Welder: Anya Kulinchenko-Braun Welding Method used: GTAW

Type of Filler Material: ER80S-D2 Shielding Gas Used: 100% Argon

4.Equivalency calculations if needed (attach to this sheet).

5.All welds and/or other attachment methods must be checked for integrity. Faculty advisor and team captain are required to do destructive testing on sample joints that represent the integrity of similar welds on their frame. Testing and inspection must occur before roll cage fabrication is started.

Date of inspection: January 31, 2022

NOTE: It is extremely important that such an inspection be made to ensure the welds have good penetration and joints are completely welded.

WE HAVE EXAMINED THE ABOVE INFORMATION AND TO THE BEST OF OUR KNOWLEDGE DEEM IT TO BE ACCURATE.

TEAM CAPTAIN: Anya Kulinchenko-Braun (SIGNATURE) 1/31/22 (DATE)

FACULTY ADVISOR: (SIGNATURE) 1/31/22 (DATE)

Bring a signed and completed copy of this form with you to technical inspection FOR EACH COMPETION your team is entering.

School Name:	Northern Arizona Univ

BAJA SAE ROLL CAGE SPECIFICATION SHEET
2022 BAJA SAE COMPETITIONS

SCHOOL NAME Northen Arizona University CAR NUMBER 29

The competition in which you are competing: BAJA SAE Tennessee

This sheet MUST be completed and submitted in accordance with the competition rules. Failure to do so will result in penalty.

Purpose: The purpose of this sheet is to facilitate verification of roll cage materials/construction, and to provide a means of tracking the age of older vehicles. This is being done in the interest of good engineering practice and confirming the fabrication techniques of the team.

1.Academic year the cage was constructed? 2021-2022

2.Material Type (i.e.: 4130): 4130 OD: 1.25in Thickness: .065in

3.Primary Welder: Ryan Kiedrowski Welding Method used: GTAW

Type of Filler Material: ER80S-D2 Shielding Gas Used: 100% Argon

4.Equivalency calculations if needed (attach to this sheet).

5.All welds and/or other attachment methods must be checked for integrity. Faculty advisor and team captain are required to do destructive testing on sample joints that represent the integrity of similar welds on their frame. Testing and inspection must occur before roll cage fabrication is started.

Date of inspection: Feburary 4th, 2022

NOTE: It is extremely important that such an inspection be made to ensure the welds have good penetration and joints are completely welded.

WE HAVE EXAMINED THE ABOVE INFORMATION AND TO THE BEST OF OUR KNOWLEDGE DEEM IT TO BE ACCURATE.

TEAM CAPTAIN: Anya Kalinchenko-Brown (SIGNATURE) 2/7/2022 (DATE)

FACULTY ADVISOR: (SIGNATURE) 2/8/2022 (DATE)

Bring a signed and completed copy of this form with you to technical inspection FOR EACH COMPETION your team is entering.

School Name:	Northern Arizona Univ

2) Material Invoice Primary

ADVANCED METAL SALES
21605 N. 26TH AVENUE
PHOENIX, AZ 85027

TEL: (623) 434-8343
FAX: (623) 434-8387

SALES ORDER

SALES ORDER	NUMBER #278786	PAGE 1	DATE 10/20/2021
SALESPERSON: PAT SARDINA			SHIP DATE: 10/20/2021
CUST P.O.#:			CUST ID: IC
JOB #:			

SOLD TO:
RYAN KIEDROWSKI

PHOENIX, AZ 85027

SHIP TO:
WILL CALL

LINE	QTY	ITEM ID/NAME	--- WIDTH ---- --- LENGTH ---	CUTTING	WEIGHT	PRICE	TOTAL
1	4 PCS	CMR114065 (4130) 1 1/4 X .065	19' 9.000"		64.78 LBS	6.1499/FT	485.84

[END ORDER]

BUYER:
PHONE #: FAX #:
TAX ID: TOTAL: 64.78 LBS

ITEM TOTAL	485.84
CUTTING	0.00
SUBTOTAL	485.84
SALES TAX	41.78
TOTAL	527.62

TERMS: CASH
$0.00 PAID

REC'D BY: _____

Advanced Metal Sales would like to thank you for your business !

School Name:	Northern Arizona Univ

2) Material Invoice Secondary

INDUSTRIAL METAL SUPPLY CO. metal made easy

Phoenix
5150 S. 48th Street
Phoenix, AZ 85040

05:00 PM Will Call Order

Order No	**6724925**
Order Date	**10/20/2021**
Customer	Z12142
Contact Name	ANSELL
Contact Number	928-499-1257
Your Ref	NAU BAJA TEAM
Sale Type	Will Call
Delivery	On 10/20/2021
ISR	Hayden Sherman
ISR #	602-218-3977

Invoice Address
Northern Arizona University
PO Box 6020
Sculpture Dept
Flagstaff, AZ, 86011

Delivery Address
Northern Arizona University
PO Box 6020
Sculpture Dept
Flagstaff, AZ, 86011

This is a reprint

Page 1 of 1

Special Instructions	Notes

Line	Product Code	Description	Qty/Footage	Unit Price	Total
1	4130RDT10006	4130 SMLS Alloy Cond-N Steel Rd Tube R/L 1 OD X .065 MIL-T6736B COND N STRESS RLVD **Size: 240" 3 pieces**	60 ff	3.751	225.06
2		Coupon 'Student and Educators Discount, 15%, $100 max' Applied			
3	Promotion	15% Off			-33.75

Please be advised:
Industrial Metal Supply Company will supply material as detailed in the line item description of our customer's submitted purchase order or written inquiry, prior to fulfillment. Any additional special compliance requirements submitted pointing to sources in customer clauses, terms, website references, portal directives, etc., that are not specified in the line item description of the product, will not be considered when fulfilling the order.

Thank you for your order!

Cut Metal: Cannot be returned for credit.
Claims for defective material must be made in writing within ten days of receipt. Claims for shortage must be made within five days of receipt.

Subject to our terms and conditions of sale.
www.industrialmetalsupply.com/terms

Payment Method	Amount Received
Visa	**$207.76**
Merchant #	191165243889
Account #	**********3012
Authorization #	013978
Amount Outstanding	**$0.00**

Sub Total	$191.31
Sales Tax	$16.45
Freight	$0.00
Order Total	$207.76

School Name:	Northern Arizona Univ

2) Material Invoice Secondary

ADVANCED METAL SALES
21605 N. 26TH AVENUE
PHOENIX, AZ 85027
TEL: (623) 434-8343
FAX: (623) 434-8387

QUOTATION

QUOTATION	NUMBER #298596	PAGE 1	DATE 11/28/2022
SALESPERSON: KEVIN HOWELL			EXPIRES: 11/30/2022
CUST P.O.#:			CUST ID: IC
JOB #:			

QUOTED TO:
CASH SALE - WALK IN

PHOENIX, AZ 85027

SHIP TO:
WILL CALL

LINE	QTY	ITEM ID/NAME	--- WIDTH ---- --- LENGTH ---	CUTTING	WEIGHT	PRICE	TOTAL
1	2 PCS	CMR1065 (4130) 1 X .065	24'		31.152 LBS	5.2308/FT	251.08
		CUT IN HALF					

[END ORDER]

BUYER:
PHONE #: FAX #:
TAX ID:

ITEM TOTAL	251.08
CUTTING	0.00
SUBTOTAL	251.08
SALES TAX	21.59
TOTAL	272.67

School Name:	Northern Arizona Univ

2) Material Invoice Primary

INDUSTRIAL METAL SUPPLY CO.
metal made easy

Phoenix
5150 S. 48th Street
Phoenix, AZ 85040

Quotation

Quote No	**4932015**
Quote Date	**11/04/2022**
Expiration Date	11/05/2022
Customer	Z12142
Contact Name	SAMUEL LARIOS
Contact Number	602-349-2767
Your Ref	NAU BAJA TEAM
Sale Type	Will Call
Delivery	On 11/04/2022
ISR	Hayden Sherman
ISR #	602-218-3977

Invoice Address
Northern Arizona University
PO Box 6020
Sculpture Dept
Flagstaff, AZ, 86011

Delivery Address
Northern Arizona University
PO Box 6020
Sculpture Dept
Flagstaff, AZ, 86011

We are pleased to offer the following, subject to Credit approval. All prices and quantities are subject to change based on availability and price in effect at time of shipment or order confirmation. Unless otherwise noted, this offering is based on all items and quantities shipped at one time. Multiple shipments or additional packaging requirements will be subject to additional charges. Order values that do not meet the delivery minimum, multiple shipments or additional packaging requirements will be subject to additional charges.

Special Instructions	Notes

Line	Product Code	Description	Qty/Footage	Unit Price	Total
1	4130RDT12506	4130 SMLS Alloy Cond-N Steel Rd Tube R/L 1 1/4 OD X .065 MIL-T6736B COND N STRESS RLVD **Size: 288" 2 pieces**	48 lf	6.16	295.68
2		Coupon 'Student and Educators Discount, 15%, $100 max' Applied			
3	Promotion	15% Off			-44.35

Please be advised:
Industrial Metal Supply Company will supply material as detailed in the line item description of our customer's submitted purchase order or written inquiry, prior to fulfillment. Any additional special compliance requirements submitted pointing to sources in customer clauses, terms, website references, portal directives, etc., that are not specified in the line item description of the product, will not be considered when fulfilling the order.

May we start your order? Please sign and return:

Buyer _____ Date _____

Subject to our terms and conditions of sale.
www.industrialmetalsupply.com/terms

Sub Total	$251.33
Sales Tax	$21.61
Freight	$0.00
Quotation Total	$272.94

School Name:	Northern Arizona Univ

3) Material Certification Primary

WEBCO INDUSTRIES

MATERIAL TEST REPORT

Sold To: 3301810	Ship To: 3301810
RELIABLE SOURCE INC. 11109 JASMINE STREET FONTANA CA 92337	RELIABLE SOURCE INC. 11109 JASMINE STREET FONTANA CA 92337

Purchase Order: 910784
Sales Order: 272615
Material: A888125006506360 AMS-6360 1.250OD .065AW FinishLineCrMo™
Delivery / File Nbr: 80472188

Description: AMS-6360P/AMS-T-6736B COND N./MIL-T-6736B ASTM A519-17 AMS-T-6736B S4130

Test: NDT ELECTRIC TESTED TO ASTM A450 OR A1016 & APPLICABLE TEST METHOD E309 OR E426. MAGNETIC INSPECTED TO AMS2301.

Heat Number:		183780	249928	622119
		%	%	%
CARBON	LDL	0.290	0.300	0.300
MANGANESE	LDL	0.470	0.510	0.540
PHOSPHORUS	LDL	0.010	0.014	0.012
SULFUR	LDL	0.002	0.002	0.002
SILICON	LDL	0.260	0.240	0.210
NICKEL	LDL	0.020	0.050	0.090
CHROMIUM	LDL	0.870	0.830	0.880
MOLYBDENUM	LDL	0.160	0.200	0.150
COPPER	LDL	0.029	0.010	0.140
NITROGEN	LDL	**	**	**
**Not Reported				
Ultimate (PSI)		109041 / 109468	114464 / 114535	103587 / 104019
Yield (PSI)		81,707 / 82,154	87,606 / 88,844	80,074 / 82,574
Elongation (%)		25 / 26	25 / 25	25 / 25
Hardness (HRBW)		92 / 92	99 / 99	98 / 98
Grain Size		8.500	8.500	8.000
Frequency rate		0.000	0.130	0.020
Severity		0.000	0.160	0.010
Decarb OD Complete (IN)		PASSED	PASSED	PASSED
Decarb ID Complete (IN)		PASSED	PASSED	PASSED
Decarb OD Partial (IN)		PASSED	PASSED	PASSED
Decarb ID Partial (IN)		PASSED	PASSED	PASSED
Origin of Melt		Brazil	Germany	Germany

Webco Industries, Inc. certifies that the material described was manufactured and tested and/or inspected in accordance with the specification and fulfills requirements in such respect. This document conforms to the requirements of Specification EN 10204 Inspection Document Type 3.1.

Date: 05/13/2021

Tim Benear

Tim Benear
Quality Manager
TBENEAR@WEBCOINDUSTRIES.COM

3116 East 31st Street North
Tulsa OK 74110

Webco Industries | 9101 W 21st Street | Sand Springs, OK 74063 USA | (918)245-2211

School Name:	Northern Arizona Univ

3) Material Certification Secondary

WEBCO INDUSTRIES

MATERIAL TEST REPORT

Sold To: 3301810	Ship To: 3301810
RELIABLE SOURCE INC. 11109 JASMINE STREET FONTANA CA 92337	RELIABLE SOURCE INC. 11109 JASMINE STREET FONTANA CA 92337

Rectangular Snip

Purchase Order: 910611
Sales Order: 265780
Material: A888100006506360 AMS-6360 1.000OD .065AW FinishLineCrMo™
Delivery / File Nbr: 80463858

Description: AMS-6360P/AMS-T-6736B COND N./MIL-T-6736B ASTM A519-17
AMS-T-6736B S4130

Test: NDT ELECTRIC TESTED TO ASTM A450 OR A1016 & APPLICABLE TEST METHOD E309 OR E426. MAGNETIC INSPECTED TO AMS2301.

Heat Number: 615171

		%
CARBON	LDL	0.310
MANGANESE	LDL	0.540
PHOSPHORUS	LDL	0.008
SULFUR	LDL	0.003
SILICON	LDL	0.230
NICKEL	LDL	0.110
CHROMIUM	LDL	0.890
MOLYBDENUM	LDL	0.180
COPPER	LDL	0.200
NITROGEN	LDL	**

**Not Reported

Ultimate (PSI)	114124 / 114401
Yield (PSI)	88,184 / 88,434
Elongation (%)	23 / 23
Hardness (HRBW)	98 / 98
Grain Size	8.500
Frequency rate	0.020
Severity	0.010
Decarb OD Complete (IN)	PASSED
Decarb ID Complete (IN)	PASSED
Decarb OD Partial (IN)	PASSED
Decarb ID Partial (IN)	PASSED
Origin of Melt	Germany

266559 4130RDT10006
HN# 615171
PO# 53647

Webco Industries, Inc. certifies that the material described was manufactured and tested and/or inspected in accordance with the specification and fulfills requirements in such respect. This document conforms to the requirements of Specification EN 10204 Inspection Document Type 3.1.

Date: 01/08/2021

Tim Benear

Tim Benear
Quality Manager
tbenear@webcoindustries.com

3116 East 31st Street North
Tulsa OK 74110

Webco Industries | 9101 W 21st Street | Sand Springs, OK 74063 USA | (918)245-2211

School Name:	Northern Arizona Univ

3) Material Certification Primary

WEBCO INDUSTRIES

MATERIAL TEST REPORT

Sold To: 3300960	Ship To: 62848
NATIONAL TUBE SUPPLY-IL	NATIONAL TUBE SUPPLY (40)
9 25 CENTRAL AVENUE	22360 GOLDENCREST DRIVE
UNIVERSITY PARK IL 60466	MORENO VALLEY CA 92553

445971 4130RDT12506
H/# 632205
PO# 86020

Purchase Order:	196896
Part Number:	LINE 1 PART 1267
Sales Order:	273085
Material:	A888125006506360 AMS-6360 1.250OD .065AW FinishLineCrMo™
Delivery / File Nbr:	80485058

Description: AMS-6360P/AMS-T-6736B COND N./MIL-T-6736B ASTM A519-17
AMS-T-6736B S4130

Test: NDT ELECTRIC TESTED TO ASTM A450 OR A1016 & APPLICABLE TEST METHOD E309 OR E426. MAGNETIC INSPECTED TO AMS2301.
NO MERCURY IS INTENTIONALLY ADDED TO OUR RAW MATERIAL.

Heat Number: 632205

		%
CARBON	LDL	0.310
MANGANESE	LDL	0.540
PHOSPHORUS	LDL	0.011
SULFUR	LDL	0.002
SILICON	LDL	0.220
NICKEL	LDL	0.100
CHROMIUM	LDL	0.880
MOLYBDENUM	LDL	0.180
COPPER	LDL	0.170
NITROGEN	LDL	**

** Not Reported

Ultimate (PSI)	108498 / 110407
Yield (PSI)	86,881 / 90,031
Elongation (%)	27 / 29
Hardness (HRBW)	99 / 99
Grain Size	9.000
Frequency rate	0.020
Severity	0.100
Decarb OD Complete (IN)	PASSED
Decarb ID Complete (IN)	PASSED
Decarb OD Partial (IN)	PASSED
Decarb ID Partial (IN)	PASSED
Origin of Melt	Germany
Origin of Raw Material	Germany
Manufactured in	USA

Date: 11/22/2021

Tim Benear

Tim Benear
Quality Manager
TBENEAR@WEBCOINDUSTRIES.COM

3116 East 31st Street North
Tulsa OK 74110

Webco Industries | 9101 W 21st Street | Sand Springs, OK 74063 USA | (918)245-2211

School Name:	Northern Arizona Univ

3) Material Certification Primary

WEBCO INDUSTRIES

MATERIAL TEST REPORT

Sold To: 3300960	Ship To: 62848
NATIONAL TUBE SUPPLY-IL 925 CENTRAL AVENUE UNIVERSITY PARK IL 60466	NATIONAL TUBE SUPPLY (40) 22360 GOLDENCREST DRIVE MORENO VALLEY CA 92553

Purchase Order:	196896
Part Number:	LINE 1 PART 1267
Sales Order:	273085
Material:	A888125006506360 AMS-6360 1.250OD .065AW FinishLineCrMo™
Delivery / File Nbr:	80485058

Webco Industries, Inc. certifies that the material described was manufactured and tested and/or inspected in accordance with the specification and fulfills requirements in such respect. This document conforms to the requirements of Specification EN 10204 Inspection Document Type 3.1.

Date: 11/22/2021

Tim Benear

Tim Benear
Quality Manager
TBENEAR@WEBCOINDUSTRIES.COM

3116 East 31st Street North
Tulsa OK 74110

Webco Industries | 9101 W 21st Street | Sand Springs, OK 74063 USA | (918)245-2211

School Name:	Northern Arizona Univ

3) Material Certification Secondary

WEBCO INDUSTRIES

MATERIAL TEST REPORT

FINISHLINE CrMo

Sold To: 3301810	Ship To: 3301810
RELIABLE SOURCE INC. 11109 JASMINE STREET FONTANA CA 92337	RELIABLE SOURCE INC. 11109 JASMINE STREET FONTANA CA 92337

Purchase Order: 910964
Sales Order: 280719
Material: A888100006506360 AMS-6360 1.000OD .065AW FinishLineCrMo®
Delivery / File Nbr: 80493442

Description: AMS-6360P/AMS-T-6736B COND N./MIL-T-6736B ASTM A519-17
AMS-T-6736B S4130

Test: NDT ELECTRIC TESTED TO ASTM A450 OR A1016 & APPLICABLE TEST METHOD E309 OR E426.
MAGNETIC INSPECTED TO AMS2301.

Heat Number:		288452
		%
CARBON	LDL	0.290
MANGANESE	LDL	0.540
PHOSPHORUS	LDL	0.013
SULFUR	LDL	0.002
SILICON	LDL	0.240
NICKEL	LDL	0.110
CHROMIUM	LDL	0.830
MOLYBDENUM	LDL	0.190
COPPER	LDL	0.010
NITROGEN	LDL	**

**Not Reported

Ultimate (PSI)	107302 / 108709
Yield (PSI)	87,299 / 89,688
Elongation (%)	19 / 24
Hardness (HRBW)	99 / 99
Grain Size	8.500
Frequency rate	0.000
Severity	0.000
Decarb OD Complete (IN)	PASSED
Decarb ID Complete (IN)	PASSED
Decarb OD Partial (IN)	PASSED
Decarb ID Partial (IN)	PASSED
Origin of Melt	Germany

Webco Industries | 9101 W 21st Street | Sand Springs, OK 74063 USA | (918)245-2211

School Name:	Northern Arizona Univ

4) Supporting Calculations

Bending Stiffness

Definitions:

E = Modulus of Elasticity (205 GPa for all steels)

I = Second Moment of Area for the structural cross-section

Requirement Definitions: 25.0mm x 3.00mm, 1018

D_o = 25.0mm

D_i = 19.0mm

I = $(\pi/64)*(D_o^4-D_i^4)$
= $(\pi/64)*(25.0^4-19.0^4)$
= 1.28E+04 mm^4
= 1.28E-08 m^4

$K_{b,req}$ = E*I
= (205GPa * 1.28E-08 m^4)
= 2.62E+03 $N*m^2$

Design Definitions: 31.8mm x 1.065mm, 4130

D_o = 31.8mm

D_i = 28.5mm

I = $(\pi/64)*(D_o^4-D_i^4)$
= $(\pi/64)*(31.8^4-28.5^4)$
= 1.78E+04 mm^4
= 1.78E-08 m^4

$K_{b,req}$ = E*I
= (205GPa * 1.78E-08 m^4)
= 3.65E+03 $N*m^2$

Bending Strength

Definitions:

S_y = Yield Strength (minimum specification value)

C = Distance from the neutral axis

Requirement Definitions: 25.0mm x 3.00mm, 1018

S_y = 365MPa

C = 12.5mm
= 0.0125m

$S_{b,req}$ = $(S_y * I)/C$
= (365MPa * 1.28E-08 m^4) / (0.0125m)
= 3.74E+02 N*m

Bending Strength

Definitions:

S_y = Yield Strength (minimum specification value)

C = Distance from the neutral axis

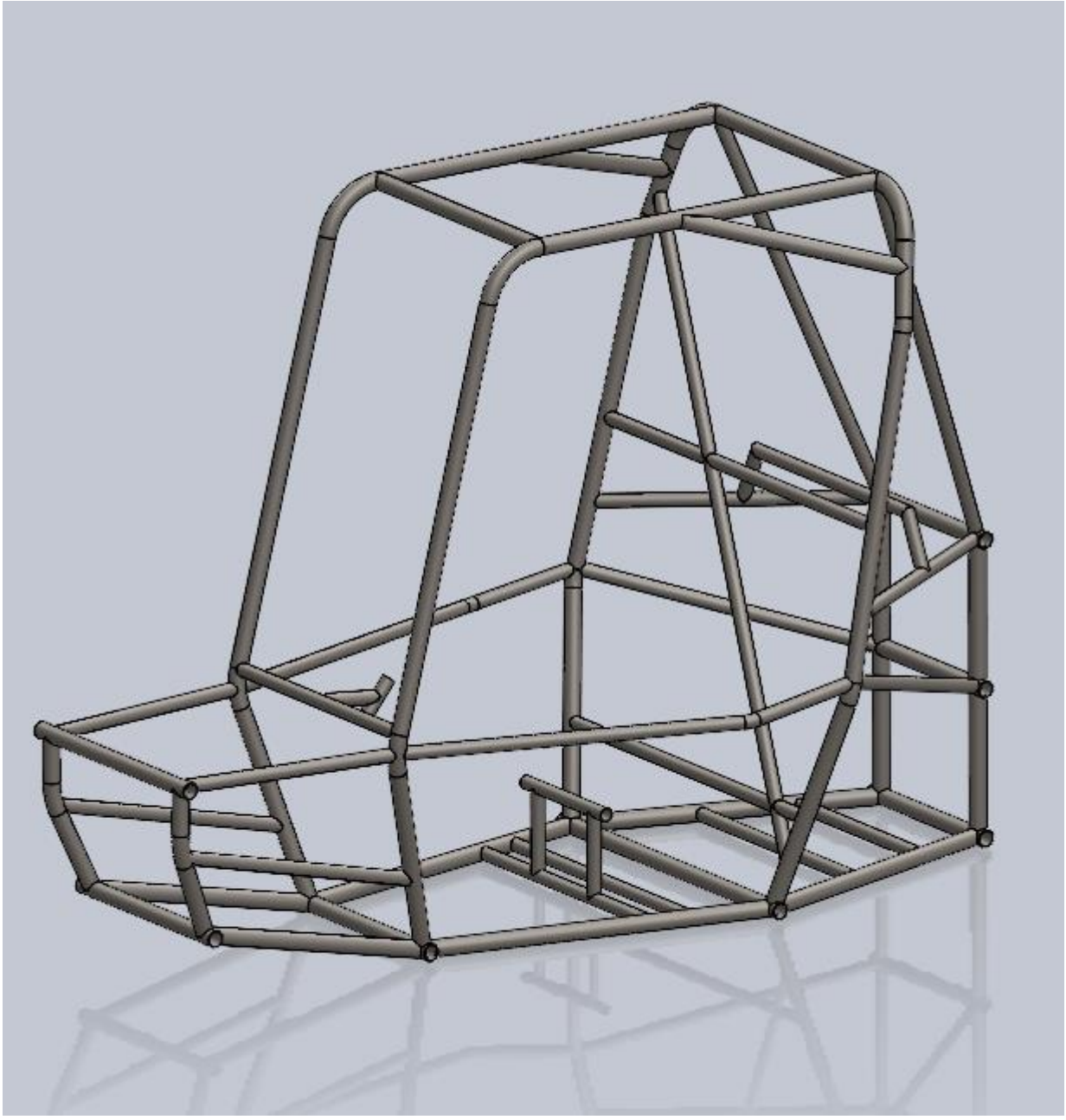
Design Definitions: 31.8mm x 2.11mm, 1018

S_y = 435MPa

C = 15.9mm
= 0.0159m

$S_{b,req}$ = $(S_y * I)/C$
= (435MPa * 1.78E-08 m^4) / (0.0159m)
= 4.87E+02 N*m

5) Diagram highlighting what parts of the frame were outsourced or professionally fabricated. An image is required even if no parts were outsourced or professionally fabricated



(No parts were professionally fabricated.)

School Name:	Northern Arizona Univ