CINDAS Databases– What's in them for me?

A tutorial on using the CINDAS Interactive databases in your library

CINDAS LLC
www.cindasdata.com

Materials Properties

- Some properties change with Temperature
  - Strength, ductility
  - Dimensions: expansion, contraction
- Some properties change with Time
- Some properties change with Cold Work

- People who design structures (cars, airplanes, bridges, ships, turbines, oil infrastructures, etc.) need reliable materials data to pick the right material for the application.
  - Always want the best performance and lowest cost

CINDAS LLC Databases

- Aerospace and High Performance Alloys Database (AHAD)
- Aerospace Structural Metals Database (ASMD)
- Thermophysical Properties of Matter Database (TPMD)
- Microelectronics and Composite Materials Database (MCMD)
- Cryogenic and Low Temperatures Database (CLTD)

Who uses this the information?

- Current corporate and research customers include:
  - Aeronautical and Aerospace Industry
  - Government and Defense Industry
  - Oil and Gas Industry
  - Automotive and Transportation Industry
  - Power Generation Industry
  - Nuclear Industry Research

Who uses this the information?

- Academic Departments and Research Groups
  - Chemical Engineering
  - Chemistry
  - Electrical and Electronics Engineering
  - Aerospace and Aeronautical Engineering
  - Materials Science
  - Mechanical Engineering
  - Nuclear Engineering
  - Physics and Applied Physics

Typical Uses for the AHAD

- Material Selection
- Failure Analysis
- Trade and Cost Studies
- Design Analysis
- Product and Process Optimization
- Equipment Selection
- Acceleration of New Product Development
- No need to Re-invent the wheel as all data is in a single source

AHAD Background Information

- More than 340 alloys are included
- 21,476 pages
- 104,307 data curves
- 12,315 technical references

DTDH – Damage Tolerant Design Handbook

- Developed by USAF (Wright Patterson)

- 5 Volume – 3600 pages
- Handbook format as PDF

- Material Characteristics data
  - Fracture Toughness (plane stress and plane strain)
  - Fatigue Crack Growth
  - R-Curves
  - Sustained load
  - SCC Threshold data
- Alloy Groups
  - Alloy Steel
  - Stainless Steel
  - Nickel Base
  - Titanium
  - Aluminum (60% of the handbook)

TPMD – Thermophysical Properties of Matter Database

- Data and information on thermophysical properties
- Web-based format
- 5,269 materials
- 96 material groups
- 53,623 data curves

•MCMD- Microelectronic and Composite Materials Database

•Upgraded and expanded version of the Microelectronics Packaging Materials Database (MPMD).

• It contains everything in the MPMD (data and information on thermal, mechanical, electrical and physical properties of electronics packaging material

• Plus more than 200 composite materials

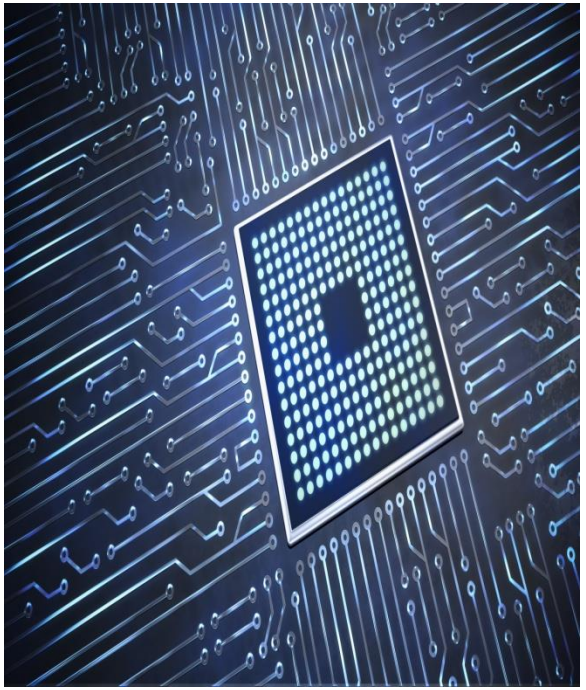
•Ceramic matrix composites, both particulate and whisker reinforced

•GLARE materials (Glass Laminate Aluminum Reinforced Epoxy also known as GLAss Reinforced laminate)

•Web-based format

•Nearly 1,400 materials

•Contains over 30,575 data curves



CLTD—Cryogenic and Low Temperatures Database

- CINDAS developed a new product offering of material characteristics in the cryogenic and low temperature ranges. Most data will be in the temperature ranges 0 K to 273 K
- It consists of thermophysical, mechanical, electrical and other properties for over 2000 materials
- It consists of thermophysical, mechanical, electrical and other properties for over 2000 materials
- Optimal single source for cryogenic and low temperature data

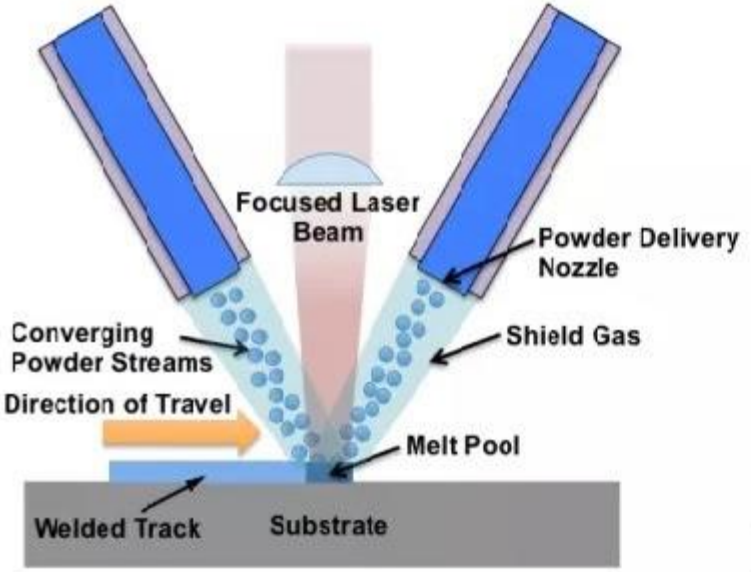
Amount of Data And Types of Properties

- 23,000+ data curves
- 48% of data curves are thermophysical properties vs temperature.
- 47% of the data curves are mechanical properties vs temperature.
- Breakdown of the different property types
  - ✓11,000 data curves of thermophysical properties
  - ✓600 data curves of thermoradiative properties
  - ✓400 data curves of electrical and nuclear properties
  - ✓11,000 mechanical properties (strength, modulus, fatigue, strain rate, fracture toughness, etc.)
  - ✓100 data curves for other properties
  - ✓In total there are 250 property types in the CLTD

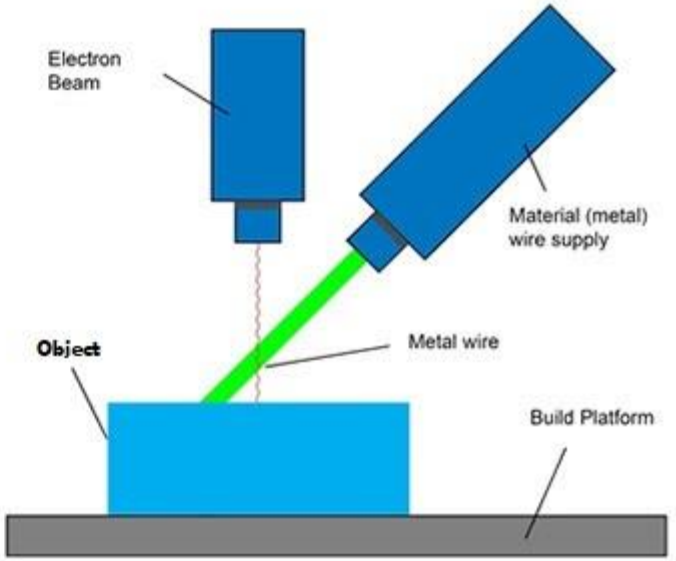
Additive Manufacturing

- CINDAS has added new chapters on the most widely used Titanium alloy in additive manufacturing: Ti-6Al-4V
- A second chapter has been added on the most popular Aluminum alloy being used in additive manufacturing: AlSi10Mg
- Newest AM chapter will be added in early 2023 on IN 718

Additive Manufacturing of Ti-6Al-4V



Powder Fed/Laser DED Process



Wire Fed/Electron Beam DED Process

CINDAS Products Provide Important Data on Engineering Properties for Structural Materials

- **Corrosion**
  - How long a material will survive in a corrosion situation
- **Mechanical Strength**
  - Yield Strength – stress for permanent deformation
  - Tensile Strength – stress at Fracture
  - Strongly affected by temperature
- **Modulus** (stiffness)
  - How much a material will deform elastically under load
- **Ductility/Elongation**
  - How much a material will "stretch" before it breaks
- **Fracture Toughness**
  - In the presence of a crack, will the material survive the stress?
- **Fatigue**
  - During non-constant (cyclic) stresses, what is the lifetime of a material?

Six Major Alloy Groups
Contain 90% of all alloys in the AHAD

- 30% Nickel/Cobalt
- 20% Stainless Steel
- 15% Aluminum
- 10% High Strength Steel
- 8% Titanium
- 7% Magnesium

Portion of AHAD Alloy Sheet found on CINDAS LLC webpage

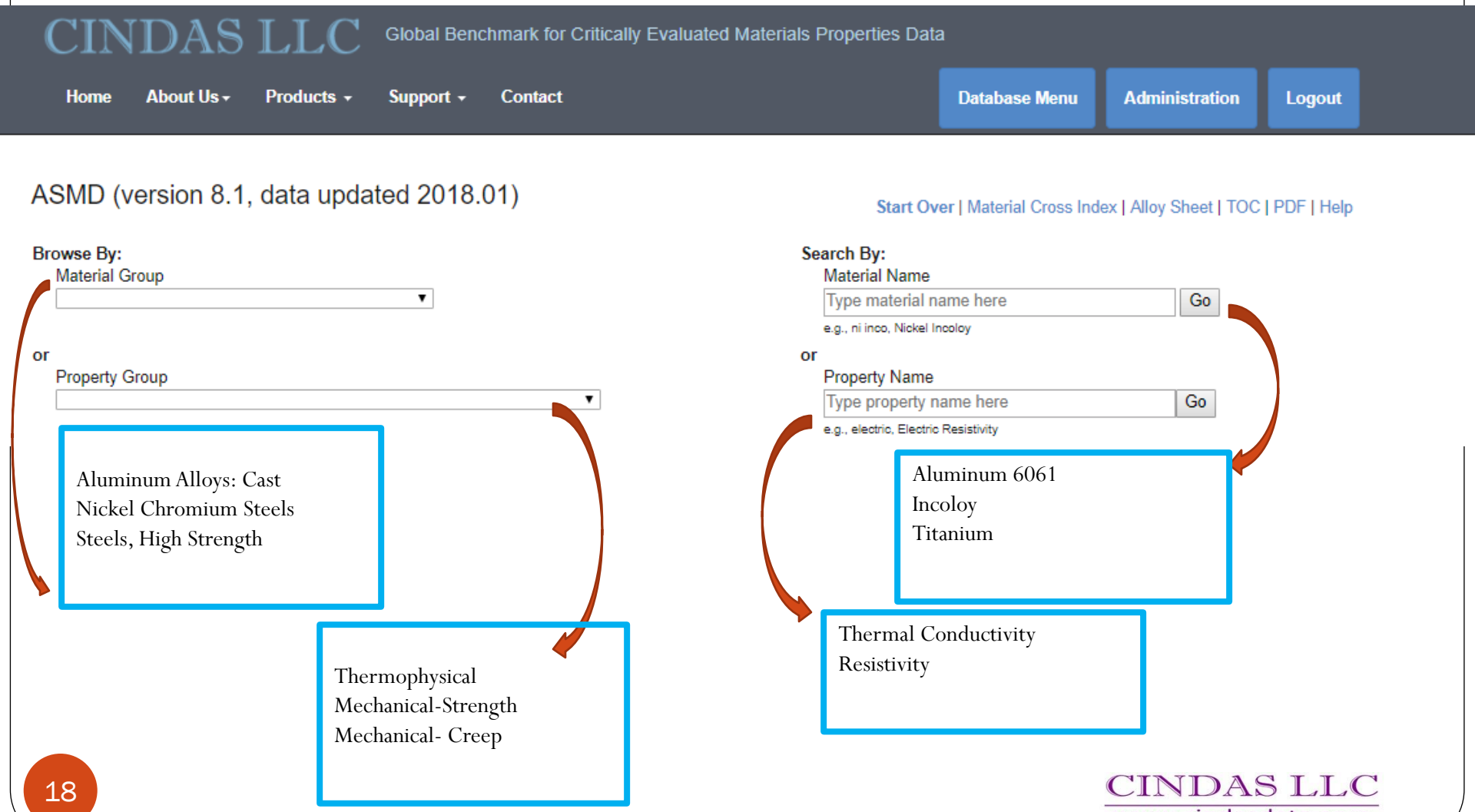
AEROSPACE AND HIGH PERFORMANCE ALLOYS DATABASE (AHAD)

GRADE	UNS
NICKEL BASED ALLOYS <5% CO	
Custom Age 625 Plus®	**N07716**
D979	N09979
HASTELLOY® B-3®	**N10675**
HASTELLOY® C-22HS®	**N07022**
HASTELLOY® C-276	**N10276**
HASTELLOY® C-2000®	**N06200**
HASTELLOY® X	N06002
HAYNES® G-35®	**N06035**
HAYNES® 230®	N06230
HAYNES® 242®	None
HAYNES® HR-160®	**N12160**
INCOLOY® 601	N06601
INCOLOY® 825	**N08825**
INCOLOY® 901	N09901
INCOLOY® 925	**N09925**
INCONEL® 600	N06600
INCONEL® 625	N06625
INCONEL® 690	**N06690**
INCONEL® 702	N07702
INCONEL® 706	N09706
INCONEL® 713 LC	N07713
INCONEL® 713C	N07713
INCONEL® 718	N07718
INCONEL® 722™	N07722
INCONEL® MA 6000	None
INCONEL® MA 754	N07754
INCONEL® X-750	N07750
MONEL® K-500	N05500
NIMONIC® 80A	**N07080**
RA-333	N06333
TD Nickel	N03260
TD NiCr	None
NICKEL CHROMIUM STEELS	

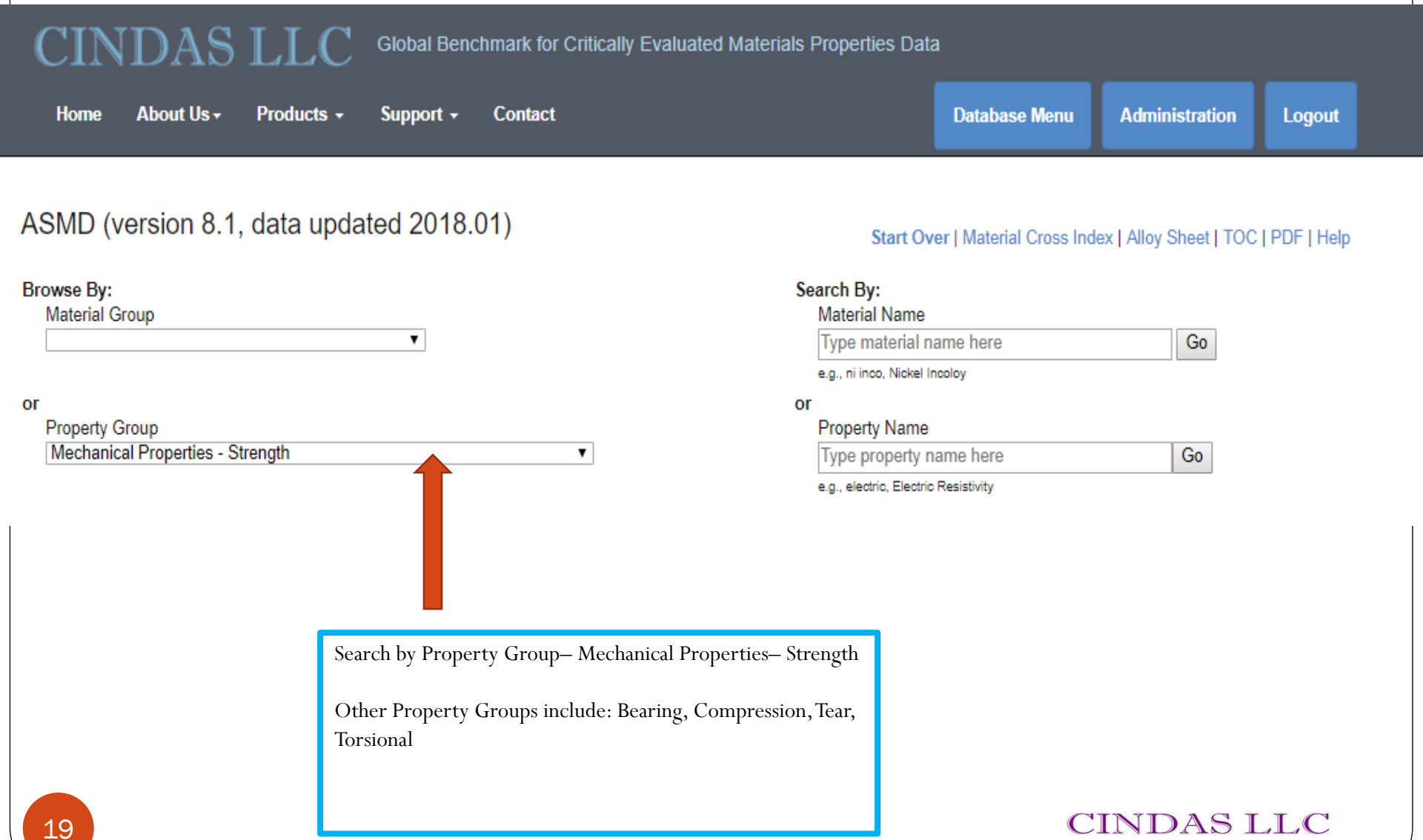
GRADE	UNS
NICKEL BASED ALLOYS >5% CO	
ATI 718Plus®	N07818
ATI M-252™	N07252
B-1900	None
CMSX-4®	None
HAYNES® 263	N06231/N07263
HAYNES® 282®	N07208
IN® 100	N13100
IN-738	None
INCOLOY® 909	N19909
INCONEL® 617	N06617
INCONEL® 783	R30783
Mar-M-246	None
Mar-M-247®	None
MP35N®	**R30035**
Nicrotung	None
NIMONIC® 105	None
NIMONIC® 115	None
NIMONIC® 90	N07090
René® 41	N07041
René® 80	None
René® 95	None
UDIMET® 500	N07500
UDIMET® 700	None
UDIMET® 720	None
WASPALOY™	N07001
TITANIUM ALLOYS	
Wrought	
Commercially Pure	R50250/R50400/ R50550/R50700
10-2-3	R56410
15-3	None
17	R58650
1Al-8V-5Fe	None

GRADE	UNS
MAGNESIUM ALLOYS	
Cast	
AM100A	M10100
AZ63A	M11630
AZ91	M11910
AZ92A	M11920
EZ33A	M12330
HZ32A	M13320
QE22A	M18220/M18221
ZH62A	M16620
ZK51A	M16510/M16511
ZK61A	M16610/M16611
Wrought/Heat Treatable	
AZ80A	M11800
EK31XA	None
HK31A	M13310
HM21A	M13210
HM31A	M13312
LA91A	None
ZK60A	M16600
Wrought/Non-Heat Treatable	
AZ31A, C & D	M11311/M11312
AZ31B	M11311/M11312
AZ61A	M11610
ZE10A	M16100
BERYLLIUM ALLOYS	
Beryllium	None
Lockalloy	None
COLUMBIUM (NIOBIUM) ALLOYS	
Commercially Pure	None
B-66	S31266
Cb-129 Y	None
Cb-132/132M	None

Four Ways to Search the Database

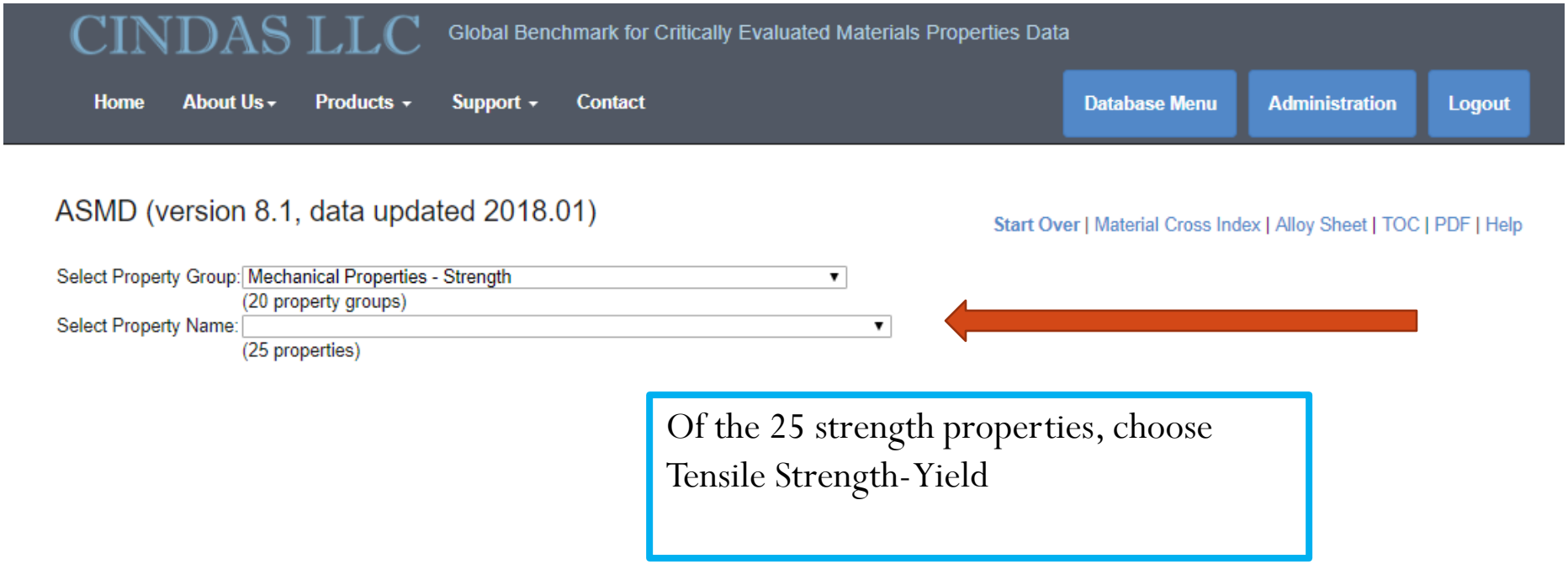


To compare same property of two or more materials search by property group.



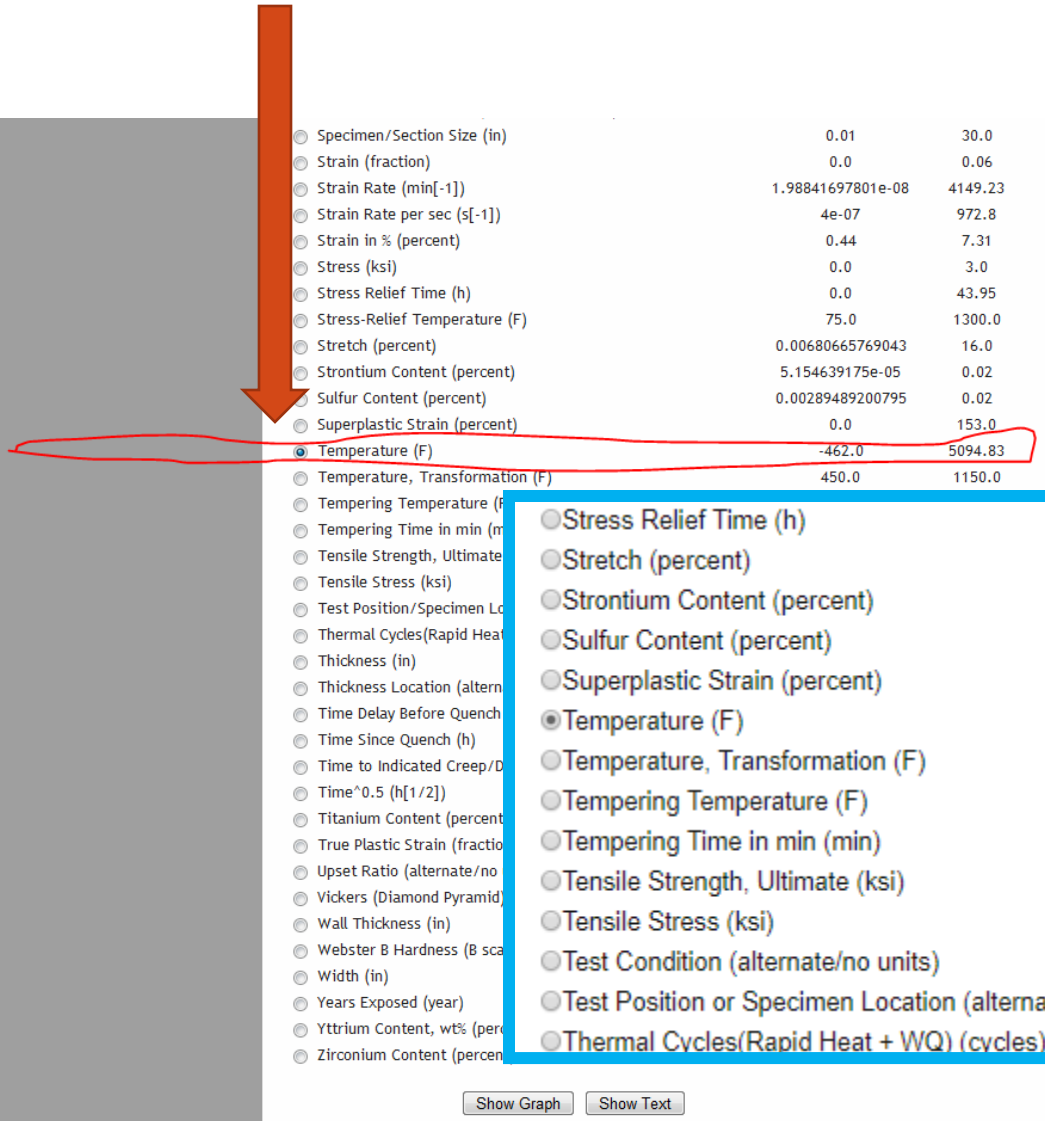
Search by Property Group– Mechanical Properties– Strength

Other Property Groups include: Bearing, Compression, Tear, Torsional



Of the 25 strength properties, choose Tensile Strength-Yield

Choose Temperature as Independent Variable



Specimen/Section Size (in)	0.01	30.0
Strain (fraction)	0.0	0.06
Strain Rate (min[-1])	1.98841697801e-08	4149.23
Strain Rate per sec (s[-1])	4e-07	972.8
Strain in % (percent)	0.44	7.31
Stress (ksi)	0.0	3.0
Stress Relief Time (h)	0.0	43.95
Stress-Relief Temperature (F)	75.0	1300.0
Stretch (percent)	0.00680665769043	16.0
Strontium Content (percent)	5.154639175e-05	0.02
Sulfur Content (percent)	0.00289489200795	0.02
Superplastic Strain (percent)	0.0	153.0
Temperature (F)	-462.0	5094.83
Temperature, Transformation (F)	450.0	1150.0
Tempering Temperature (F		
Tempering Time in min (m		
Tensile Strength, Ultimate		
Tensile Stress (ksi)		
Test Position/Specimen Lo		
Thermal Cycles(Rapid Heat		
Thickness (in)		
Thickness Location (altern		
Time Delay Before Quench		
Time Since Quench (h)		
Time to Indicated Creep/D		
Time^0.5 (h[1/2])		
Titanium Content (percent		
True Plastic Strain (fractio		
Upset Ratio (alternate/no		
Vickers (Diamond Pyramid)		
Wall Thickness (in)		
Webster B Hardness (B sca		
Width (in)		
Years Exposed (year)		
Yttrium Content, wt% (per		
Zirconium Content (percen		

Show Graph | Show Text

Stress Relief Time (h)	0.0	39.45
Stretch (percent)	0.0013	16.0
Strontium Content (percent)	5.154639175e-05	0.02
Sulfur Content (percent)	0.00289591745177	0.02
Superplastic Strain (percent)	0.0	300.0
Temperature (F)	-453.0	3850.0
Temperature, Transformation (F)	575.0	625.0
Tempering Temperature (F)	67.5	1400.89
Tempering Time in min (min)	15.29	246.51
Tensile Strength, Ultimate (ksi)	138.53	279.2
Tensile Stress (ksi)	0.0	0.8
Test Condition (alternate/no units)	1.0	2.0
Test Position or Specimen Location (alternate/no units)	1.0	11.0
Thermal Cycles(Rapid Heat + WQ) (cycles)	0.0	9.53

ASMD (version 8.1, data updated 2018.01)

Property Group: Mechanical Properties - Strength
Property: Tensile Strength, Yield (ksi) Change Units ▾ Logarithmic
Independent Variable: Temperature (F) Change Units ▾ Logarithmic

Edit Select
Show Te

Select Materials ?

Select one or more materials from the list below. Hold the control key to select multiple materials. Available data curves will be displayed on the right. Then proceed to Step 2.

M102: Nickel Alloy HASTELLOY X, Ni-22Cr-18.5Fe-9Mo-1.5Co-.6W+.. UNS: N06002
M103: Nickel Alloy Haynes 230, Ni-22Cr-14W-2.5Co-2.0Mo-1.5Fe+.. Uns: N06230
M104: Nickel Alloy Haynes 242, Ni-25Mo-8Cr-2Fe-1Co+0.8Mn+..UNS: N10242
M105: Nickel Alloy Haynes 263, Ni-20Cr-20Co-5.85Mo-2.15Ti-0.7Fe+.. UNS: N06231/N07263
M106: Nickel Alloy Haynes 282, Ni-20Cr-10Co-8.5Mo-2.1Ti-1.5Fe+..

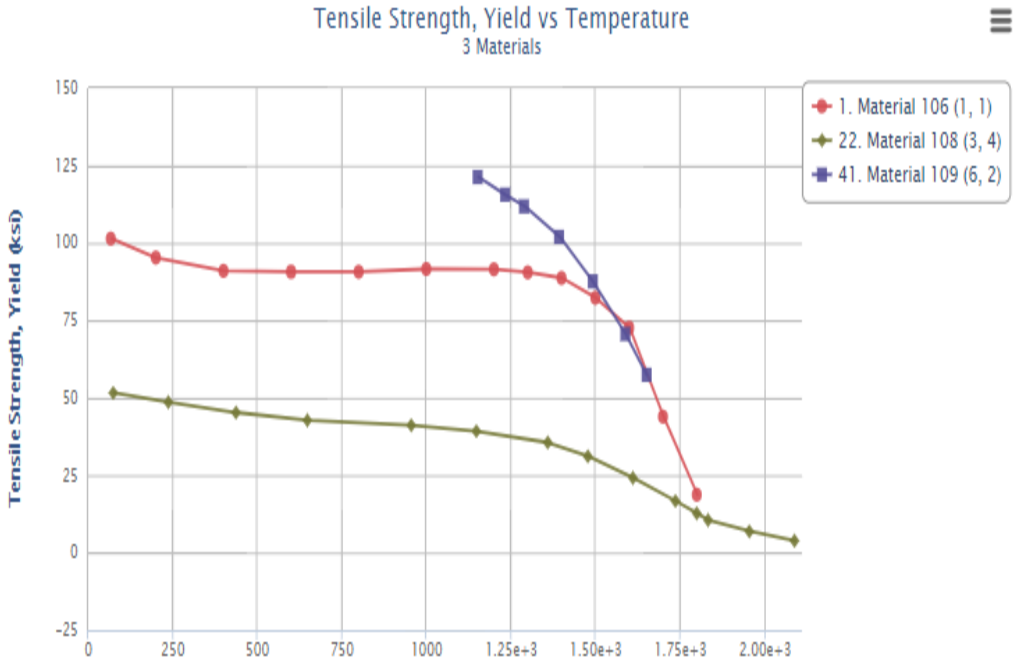
(Listing 229 materials)

Select Data Curves/Test Conditions ?

Select between one and twenty data curve descriptions from the list below to view graphs
Hold the Control key to select multiple data curves.
Key: Selected Material: (Set, Curve) - Remarks

1. M106 (1, 1) - C1: 0.2% offset, SA+age-hardened, sheet, exp data
2. M106 (2, 1) - C1: 0.2% offset, SA+age-hardened, plate, exp data
3. M106 (3, 1) - C1: 1/8" sheet autogenously welded with 1/8" dia wire, T, avg, as welded
4. M106 (3, 2) - C2: as welded/age-hardened
5. M106 (3, 3) - C3: as welded/solution annealed

Number of materials with Yield Strength vs. Temperature = 229



Choose materials 106-Haynes 282, 108-IN 601, and 109- IN 738.

Choose among sets of conditions for curves.

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ASMD (version 8.1, data updated 2018.01)

Property Group: Mechanical Properties - Strength
Property: Tensile Strength, Yield (ksi) Change Units ▾ Logarithmic
Independent Variable: Temperature (F) Change Units ▾ Logarithmic

Can change units for both property and independent variable

Strength: Mpa, ksi, psi, atm
Temperature: C, F, K, R

Edit Select
Show Te

Select Materials ?

Select one or more materials from the list below. Hold the control key to select multiple materials. Available data curves will be displayed on the right. Then proceed to Step 2.

M102: Nickel Alloy HASTELLOY X, Ni-22Cr-18.5Fe-9Mo-1.5Co-.6W+.. UNS: N06002
M103: Nickel Alloy Haynes 230, Ni-22Cr-14W-2.5Co-2.0Mo-1.5Fe+.. Uns: N06230
M104: Nickel Alloy Haynes 242, Ni-25Mo-8Cr-2Fe-1Co+0.8Mn+..UNS: N10242
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(Listing 229 materials)

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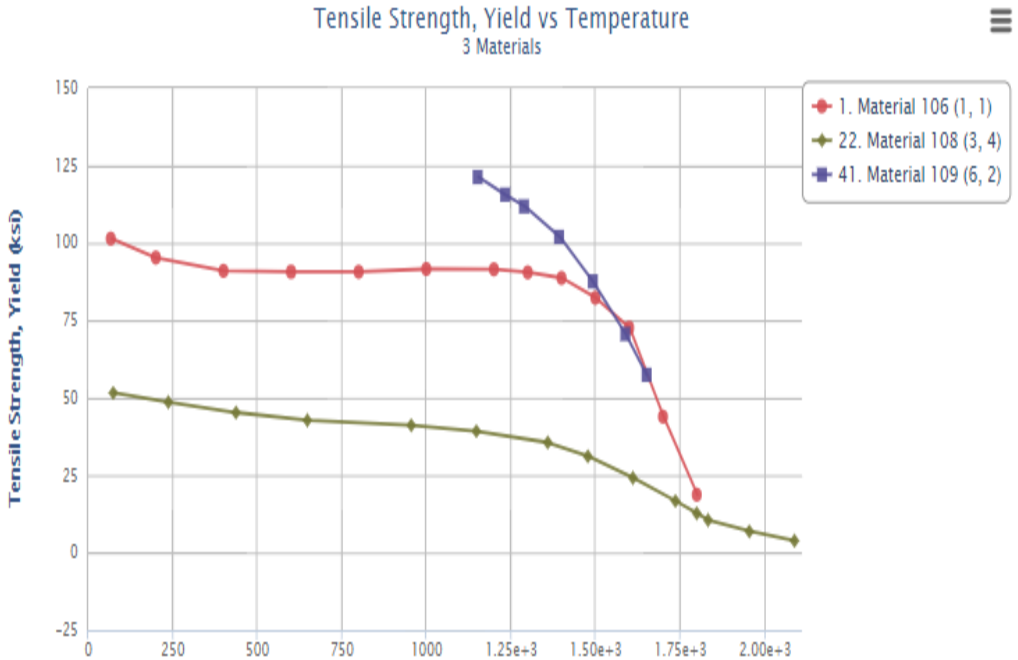
Hold the Control key to select multiple data curves.
Key: Selected Material: (Set, Curve) - Remarks

1. M106 (1, 1) - C1: 0.2% offset, SA+age-hardened, sheet, exp data
2. M106 (2, 1) - C1: 0.2% offset, SA+age-hardened, plate, exp data
3. M106 (3, 1) - C1: 1/8" sheet autogenously welded with 1/8" dia wire, T, avg, as welded
4. M106 (3, 2) - C2: as welded/age-hardened
5. M106 (3, 3) - C3: as welded/solution annealed



Choose materials 106, 108, and 109.

Choose among sets of conditions for curves.

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ASMD (version 8.1, data updated 2018.01)

Property Group: Mechanical Properties - Strength
Property: Tensile Strength, Yield (ksi) Change Units ▾ Logarithmic
Independent Variable: Temperature (F) Change Units ▾ Logarithmic

Edit Select
Show Tex

Select Materials ?

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(Listing 229 materials)

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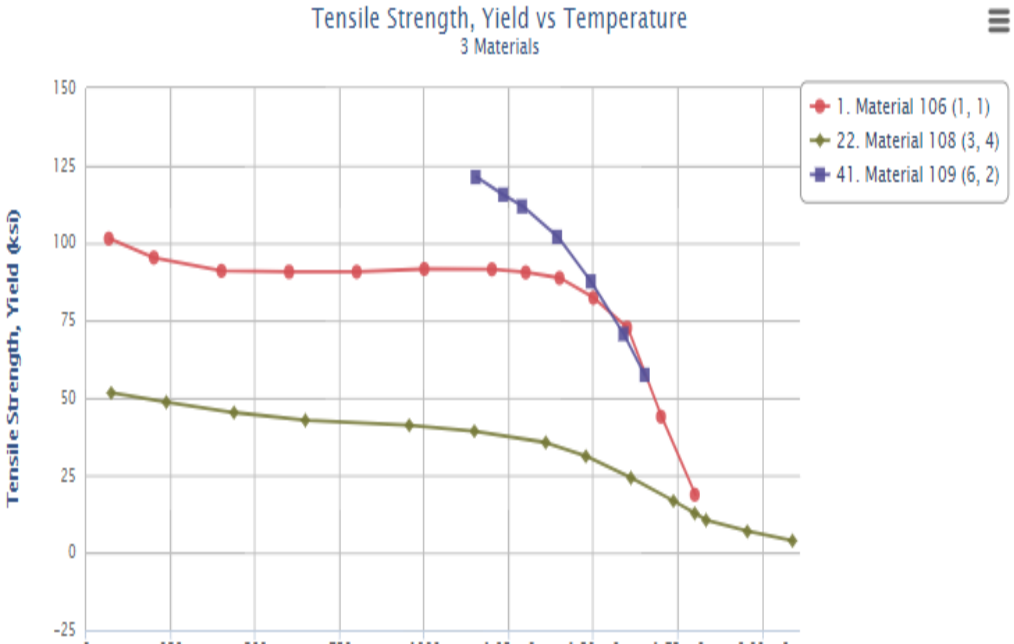
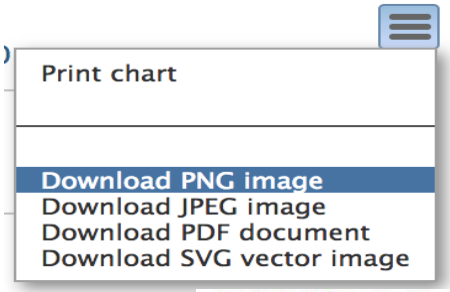
Hold the Control key to select multiple data curves.
Key: Selected Material: (Set, Curve) - Remarks

1. M106 (1, 1) - C1: 0.2% offset, SA+age-hardened, sheet, exp data
2. M106 (2, 1) - C1: 0.2% offset, SA+age-hardened, plate, exp data
3. M106 (3, 1) - C1: 1/8" sheet autogenously welded with 1/8" dia wire, T, avg, as welded
4. M106 (3, 2) - C2: as welded/age-hardened
5. M106 (3, 3) - C3: as welded/solution annealed



Choose to print or save in various formats



ASMD (version 8.1, data updated 2018.01)

Property Group: Mechanical Properties - Strength
Property: Tensile Strength, Yield (ksi) Change Units ▾ Logarithmic
Independent Variable: Temperature (F) Change Units ▾ Logarithmic

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M106: Nickel Alloy Haynes 282, Ni-20Cr-10Co-8.5Mo-2.1Ti-1.5Fe+..

(Listing 229 materials)

Select Data Curves/Test Conditions ?

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Key: Selected Material: (Set, Curve) - Remarks

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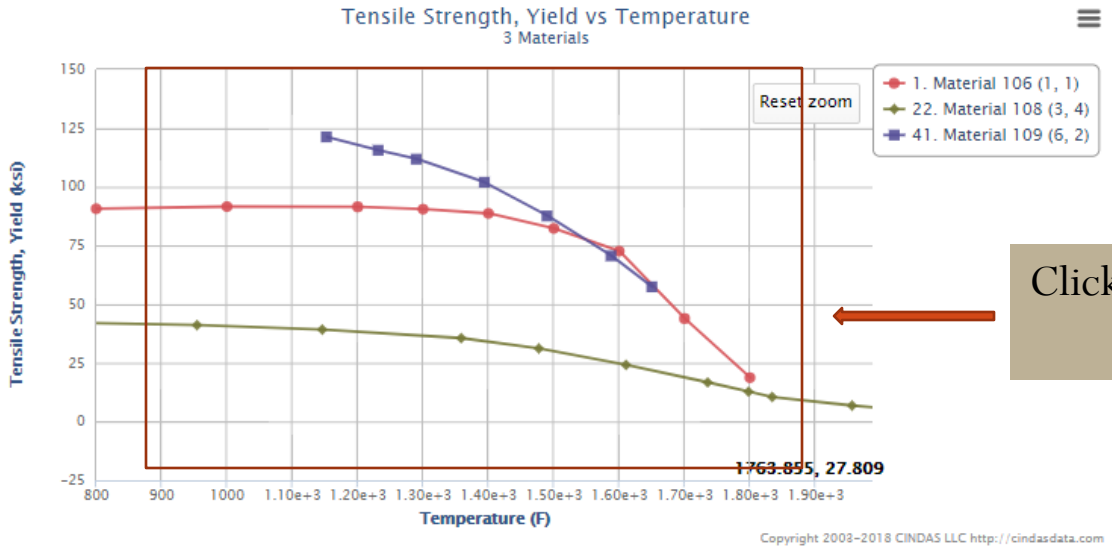
2. M106 (2, 1) - C1: 0.2% offset, SA+age-hardened, plate, exp data
3. M106 (3, 1) - C1: 1/8" sheet autogenously welded with 1/8" dia wire, T,
4. M106 (3, 2) - C2: as welded/age-hardened
5. M106 (3, 3) - C3: as welded/solution annealed



Click and drag cursor to expand graph.

Learn how to use advanced features in the Help section.

CINDAS LLC
www.cindasdata.com

CINDAS LLC Global Benchmark for Critically Evaluated Materials Properties Data

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ASMD (version 8.1, data updated 2018.01)

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Property Group: Mechanical Properties - Strength
Property: Tensile Strength, Yield (ksi) Change Units ▼ Logarithmic
Independent Variable: Temperature (F) Change Units ▼ Logarithmic

Edit Selection
Show Text

Select Materials ?

Select one or more materials from the list below. Hold the control key to select multiple materials. Available data curves will be displayed on the right. Then proceed to Step 2.

M102: Nickel Alloy HASTELLOY X, Ni-22Cr-18.5Fe-9Mo-1.5Co-.6W+.. UNS: N06002
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M106: Nickel Alloy Haynes 282, Ni-20Cr-10Co-8.5Mo-2.1Ti-1.5Fe+..

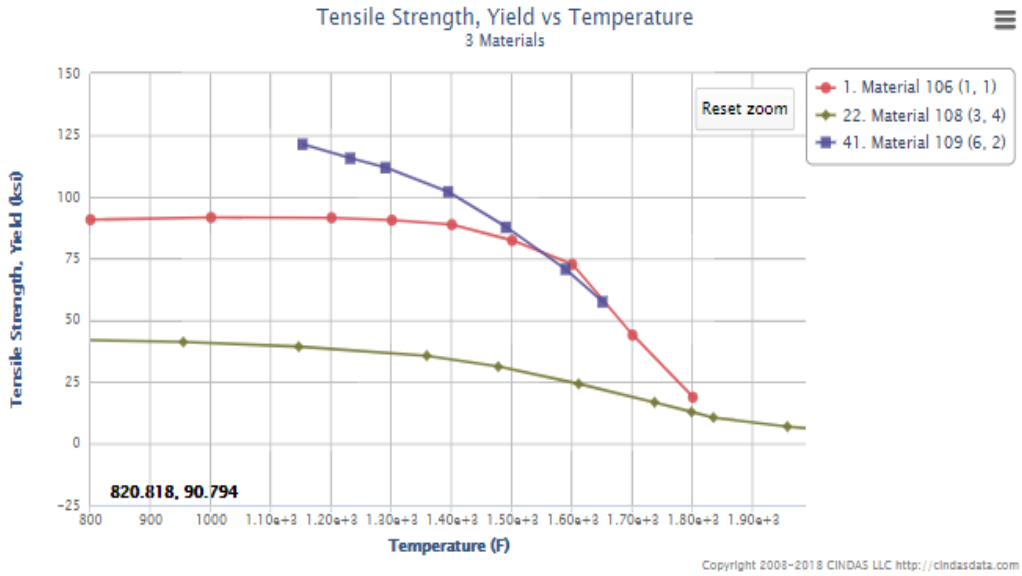
(Listing 229 materials)

Select Data Curves/Test Conditions ?

Select between one and twenty data curve descriptions from the list below to view graphs. Hold the Control key to select multiple data curves.

Key: Selected Material: (Set, Curve) - Remarks

1. M106 (1, 1) - C1: 0.2% offset, SA+age-hardened, sheet, exp data
2. M106 (2, 1) - C1: 0.2% offset, SA+age-hardened, plate, exp data
3. M106 (3, 1) - C1: 1/8" sheet autogenously welded with 1/8" dia wire, T, avg, as welded
4. M106 (3, 2) - C2: as welded/age-hardened
5. M106 (3, 3) - C3: as welded/solution annealed



Click on SHOW TEXT link to get actual data points, test conditions and references.

Learn how to use advanced features in the Help section.

CINDAS LLC
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ASMD (version 8.1, data updated 2018.01)

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Property Group: Mechanical Properties - Strength
Property: Tensile Strength, Yield (ksi) Change Units ▾ Logarithmic
Independent Variable: Temperature (F) Change Units ▾ Logarithmic

Edit Selection
Show Graph

Select Materials ?

Select one or more materials from the list below. Hold the control key to select multiple materials. Available data curves will be displayed on the right. Then proceed to Step 2.

M102: Nickel Alloy HASTELLOY X, Ni-22Cr-18.5Fe-9Mo-1.5Co-.6W+.. UNS: N06002
M103: Nickel Alloy Haynes 230, Ni-22Cr-14W-2.5Co-2.0Mo-1.5Fe+.. Uns: N06230
M104: Nickel Alloy Haynes 242, Ni-25Mo-8Cr-2Fe-1Co+0.8Mn+..UNS: N10242
M105: Nickel Alloy Haynes 263, Ni-20Cr-20Co-5.85Mo-2.15Ti-0.7Fe+.. UNS: N06231/N07263
M106: Nickel Alloy Haynes 282, Ni-20Cr-10Co-8.5Mo-2.1Ti-1.5Fe+..

(Listing 229 materials)

Select Data Curves/Test Conditions

Select a dataset from the box to show text

1. M106 (1, 1) - C1: 0.2% offset, SA+age-hardened, sheet, exp data
2. M106 (2, 1) - C1: 0.2% offset, SA+age-hardened, plate, exp data
3. M106 (3, 1) - C1: 1/8" sheet autogenously welded with 1/8" dia wire, T, avg, as welded
4. M106 (3, 2) - C2: as welded/age-hardened
5. M106 (3, 3) - C3: as welded/solution annealed

```
Material:            Nickel Alloy Haynes 282, Ni-20Cr-10Co-8.5Mo-2.1Ti-1.5Fe+..
Property:            Tensile Strength, Yield (ksi)
Independent Variable: Temperature (F)

Nickel Alloy Haynes 282, Ni-20Cr-10Co-8.5Mo-2.1Ti-1.5Fe+..

Tensile properties for sheet from room temperature to 1800 F.
(Fty, 0.2% offset, for this data set)

Specimen Form: Sheet.
Condition: Solution annealed at 2100F (1149C) +
    Age-Hardening: 1850F (1010C)/2h/AC + 1450F (788C)/8h/AC.
Test Condition: Temperature (X-var): at different levels, 70-1800 F.
Data were provided by author. Multiple heats and product sizes were used to determine
average values which were reported.

Data Points
    X            Y


Curve: 1
7.0000e+01    1.0140e+02
2.0000e+02    9.5300e+01
4.0000e+02    9.1000e+01
6.0000e+02    9.0700e+01
8.0000e+02    9.0700e+01
1.0000e+03    9.1600e+01
1.2000e+03    9.1500e+01
1.3000e+03    9.0500e+01
1.4000e+03    8.8700e+01
1.5000e+03    8.2300e+01
1.6000e+03    7.2600e+01
1.7000e+03    4.3900e+01
1.8000e+03    1.8700e+01
```

Conditions

Data

Typical conditions:
Material type(plate, sheet, extrusion, forging
Thickness
Heat treatment
Direction of test (L, LT, ST)

ASMD (version 8.1, data updated 2018.01)

Property Group: Mechanical Properties - Strength
Property: Tensile Strength, Yield (ksi) Change Units ▼ Logarithmic
Independent Variable: Temperature (F) Change Units ▼ Logarithmic

Edit Selection
Show Graph

Select Materials ?

Select one or more materials from the list below. Hold the control key to select multiple materials. Available data curves will be displayed on the right. Select a dataset from the box to show text.
Then proceed to Step 2.

M102: Nickel Alloy HASTELLOY X, Ni-22Cr-18.5Fe-9Mo-1.5Co-.6W+.. UNS: N06002
M103: Nickel Alloy Haynes 230, Ni-22Cr-14W-2.5Co-2.0Mo-1.5Fe+.. Uns: N06230
M104: Nickel Alloy Haynes 242, Ni-25Mo-8Cr-2Fe-1Co+0.8Mn+..UNS: N10242
M105: Nickel Alloy Haynes 263, Ni-20Cr-20Co-5.85Mo-2.15Ti-0.7Fe+.. UNS: N06231/N07263
M106: Nickel Alloy Haynes 282, Ni-20Cr-10Co-8.5Mo-2.1Ti-1.5Fe+..

(Listing 229 materials)

Select Data Curves/Test Conditions

25. M108 (4, 3) - C3: Smooth Curve
26. M108 (5, 1) - C1: Plate, Butt-Welded, Filler Metal Inconel 601, Exp Data
27. M108 (5, 2) - C2: Smooth Curve
28. M109 (1, 1) - C1: HT cond 1 (2120 F + 1920 F + 1580 F)
29. M109 (1, 2) - C2: HT cond 2 (2120 F to 1920 F to 1580 F)

```
Material:            Nickel Alloy IN 601, Ni-23Cr-1.5Al-14Fe UNS: N06601
Property:            Tensile Strength, Yield (ksi)
Independent Variable: Temperature (F)

Nickel Alloy IN 601, Ni-23Cr-1.5Al-14Fe

Effects of elevated temperatures on tensile property (Fty) of transverse
butt-weld joints made by gas tungsten arc process.

Specimen Form: Butt-welded 0.500" Plate.
Specimen Specification: Filler metal -  Inconel 601.
Specimen Condition: As-welded.
Tested from RT to ~2100F.

C1: Exp Data;
C2: Smooth Curve.

Data Points
      X           Y


Curve: 1
8.5958e+01    4.8436e+01    C1: Exp Data
1.0035e+03    3.8074e+01
1.4083e+03    3.4400e+01
1.7935e+03    1.2206e+01
2.0004e+03    7.1240e+00
2.0960e+03    4.2668e+00

Curve: 2

8.5958e+01    4.8436e+01    C2: Smooth Curve
2.4653e+02    4.5099e+01
4.9056e+02    4.1755e+01
8.3973e+02    3.9195e+01
1.1364e+03    3.7113e+01
1.3279e+03    3.5198e+01
1.4329e+03    3.3132e+01
1.5100e+03    2.9168e+01
1.5839e+03    2.3621e+01
1.6640e+03    1.7916e+01
1.7658e+03    1.3475e+01
```

Curves from same reference are shown together.

Material: Nickel Alloy Haynes 263, Ni-20Cr-20Co-5.85Mo-2.15Ti-0.7Fe+..
Property: Tensile Strength, Yield (ksi)
Independent Variable: Temperature (F)

Nickel Alloy Haynes 263, Ni-20Cr-20Co-5.85Mo-2.15Ti-0.7Fe+..

The alloy is solution heat treated at 2100F+/-25F and rapidly cooled
or water quenched for optimum properties.
Following solution heat treatment, the alloy is aged-hardened at 1472F
(800C)/8 hours and air cooled. (Refs. 1, 2)

Tensile properties for sheet from room temperature to 2000F. (Fty,0.2% offset for this data set)

Specimen Form: Sheet.
Condition: 1. SA;
2. SA + 1472F/8h/AC.
Test Temperature (X-var): at different levels, RT-2000F.
Experimental data were reported for all curves.

C1: SA;
C2: SA + 1472F/8h/AC.

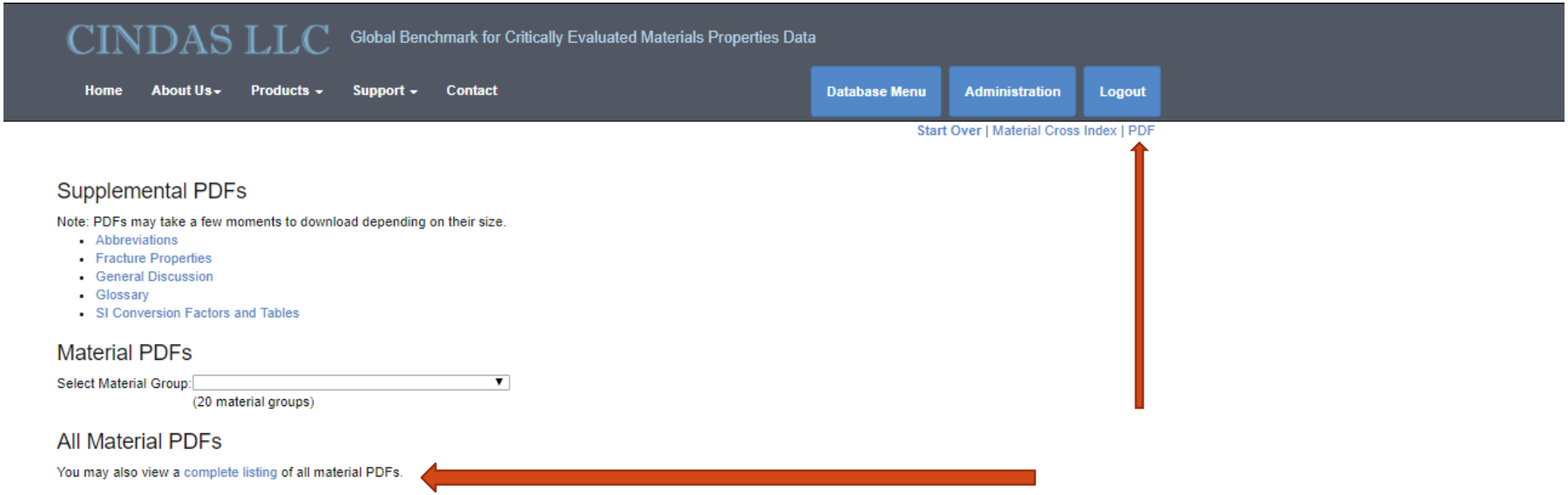
Data Points

X	Y	
Curve: 1		
7.5000e+01	4.9100e+01	C1: SA
Curve: 2		
7.5000e+01	8.9200e+01	C2: SA + 1472F/8h/AC
4.0000e+02	8.2300e+01	
8.0000e+02	8.0400e+01	
1.0000e+03	7.6400e+01	
1.2000e+03	7.5200e+01	
1.4000e+03	7.6000e+01	
1.5000e+03	6.8200e+01	
1.6000e+03	4.3000e+01	
1.7000e+03	1.7000e+01	
1.8000e+03	1.2300e+01	
2.0000e+03	5.5000e+00	

References:

Ref No. 8 S. K. Srivastava, Unpublished Data., Haynes Interna-
tional, Inc., 2009.

All data is referenced



Note: There are two options for viewing PDF files.

All Material PDFs

Note: PDFs may take a few moments to download depending on their size.

Aluminum Alloy 2014, Clad 2014, Al-4.5Cu-1Mn-1Si-0.5Mg UNS: A92014
Aluminum Alloy 2024, Al-4.5Cu-1.5Mg-0.6Mn UNS: A92024
Aluminum Alloy 2048, Al-3.3Cu-1.5Mg-0.4Mn UNS: A92048
Aluminum Alloy 2090, Al-2.7Cu-2.3Li-0.12Zr UNS: A92090
Aluminum Alloy 2098, Al-3.5Cu-1.1Li-0.5Mg-0.4Ag-0.11Zr
Aluminum Alloy 2099, Al-2.7Cu-1.8Li-0.7Zn-0.3Mg-0.3Mn-.08Zr UNS A92099
Aluminum Alloy 2124, Al-4.4Cu-1.5Mg-0.6Mn UNS: A92124
Aluminum Alloy 2195, Al-4.0Cu-1.0Li-0.53Mg-0.43Ag+.. UNS: A92095
Aluminum Alloy 2219, Clad 2219, Al-6.3Cu-0.3Mn-0.18Zr-0.10V-0.06Ti UNS: A92219
Aluminum Alloy 2297, Al-2.8Cu-1.2Li-0.30Mn-0.12Zr
Aluminum Alloy 2519, Al-5.9Cu-0.3Mn-0.18Mg-0.18Zr-0.1V UNS: A92519
Aluminum Alloy 2618, Al-2.5Cu-1.5Mg-1.2Ni-1.0Fe+.. UNS: A92618
Aluminum Alloy 2624 & 2026, Al-4.05/3.95Cu-1.4/1.3Mg-0.58/0.55Mn+.. UNS:A92624/A92026
Aluminum Alloy 355/A355/C355, Al-5Si-1.3Cu-0.5Mg+.. UNS: A03550/A33550
Aluminum Alloy 356.0, A356.0, Al-7Si-0.3Mg UNS: A03560/A13560
Aluminum Alloy 5052, Al-2.5Mg-0.25Cr UNS: A95052
Aluminum Alloy 5059, Al-5.5Mg-0.9Mn-0.7Zn-0.15Cr UNS: A95059
Aluminum Alloy 5083, Al-4.4Mg-0.7Mn-0.15Cr UNS: A95083
Aluminum Alloy 5456, Al-5.1Mg-0.8Mn-0.10Cr UNS: A95456
Aluminum Alloy 6013, Al-0.9Mg-0.8Si-0.85Cu-0.50Mn UNS: A96013
Aluminum Alloy 6061, Al-1Mg-0.6Si-0.25Cu-0.20Cr UNS: A96061
Aluminum Alloy 6069, Al-1.4Mg-0.75Cu-0.9Si-0.2Cr+.. UNS: A96069
Aluminum Alloy 6082, Al-1Si-0.7Mn-1Mg UNS: A96082
Aluminum Alloy 7049, Al-7.6Zn-2.5Mg-1.5Cu-0.15Cr UNS: A97049
Aluminum Alloy 7050, Al-6.2Zn-2.25Mg-2.3Cu-0.12Zr UNS: A97050
Aluminum Alloy 7055, Al-8Zn-2.3Cu-2Mg-0.16Zr UNS: A97055
Aluminum Alloy 7075 & Clad 7075, Al-5.6Zn-2.5Mg-1.6Cu-0.23Cr+.. UNS: A97075
Aluminum Alloy 7085, Al-7.5Zn-1.65Cu-1.5Mg-0.12Zr+..
Aluminum Alloy 7150, Al-6.4Zn-2.4Mg-2.2Cu-0.12Zr UNS: A97150
Aluminum Alloy 7175, Al-5.6Zn-2.5Mg-1.6Cu-0.25Cr+.. UNS: A97175
Aluminum Alloy 7475, Al-5.6Zn-2.2Mg-1.5Cu-0.21Cr+.. UNS: A97475
Aluminum Alloy 8090, Al-2.5Li-1.3Cu-1.0Mg UNS: A98090
Aluminum Alloy 905XL, Al-4.0Mg-1.3Li-1.1C-0.5O
Aluminum Alloy A201.0, Al-4.5Cu-0.7Ag-0.3Mn-0.25Mg-0.25Ti UNS: A02010
Aluminum Alloy A357.0, Al-7.0Si-0.6Mg-0.15Ti UNS: A13570
Aluminum Alloy Clad 2024, Al-4.5Cu-1.5Mg-0.6Mn UNS: A92024
Aluminum Alloy X5090, Al-7Mg-0.2Cr+..
Aluminum Alloy X7005, Al-4.6Zn-1.4Mg-0.5Mn+.. UNS: A97005
Beryllium Alloy Lockalloy, Be-38Al
Beryllium, Be
Carbon Steel T-1, Fe-0.15C-0.8Mn-0.85Ni-0.53Cr-0.50Mo+..
Cobalt Alloy Haynes 188, Co-0.1C-22Cr-22Ni-14W-0.35Si-.03La UNS: R30188
Cobalt Alloy Inconel 783, Co-28Ni-25.5Fe-3Cr-.5Mn-.5Si-.03C+..UNS: R30783
Cobalt Alloy L-605 (Haynes 25), Co-20Cr-15W-10Ni-1.5Mn-0.1C+.. UNS: R30605
Cobalt Alloy Mar-M 509, Co-24Cr-10Ni-7W-3.5Ta+Ti+Zr

Select material

Alloys can be selected by AA Designation or composition.

Complete chapter for alloy– some as long as 100 + pages

1 General

Alloy 7055 is a wrought, heat-treatable alloy developed by Alcoa in the early 1990s through compositional modifications of aluminum alloy 7150. It is particularly designed to meet the needs for advanced compression-dominated airframe applications such as the upper wing structures of large commercial aircraft. These applications required improvements in specific strength, toughness and cyclic fatigue resistance coupled with greater resistance to both exfoliation corrosion and stress corrosion cracking compared to properties of previously available alloys. Alloy 7055-T77 plate and extrusions offer a strength increase of 10 percent relative to that of 7150-T6 and 30 percent relative to that of 7150-T76. The alloy also offers high fracture toughness and excellent resistance to growth of fatigue cracks. The attractive combination of properties of 7055-T77 is attributed to the high ratios of Zn/Mg and Cu/Mg and to modified heat treatments. In the T77 temper, the 7055 alloy provides a microstructure near grain boundaries that is resistant to both intergranular fracture and intergranular corrosion.

Alloy 7055 is suitable for aerospace applications such as compression-loaded, stiffened panels that also require good toughness, fatigue and corrosion resistance. Current or candidate applications include aircraft upper wing skins and stiffeners, skins for lower horizontal stabilizers and various other types of stiffeners. It is used in the Boeing 777 aircraft. Alloy 7055 has also been selected for an advanced lightweight, rapidly deployable military bridge structure concept. (Refs. 1–4, 10)

1.1 Commercial Designation

7055

1.2 Alternate Designations

UNS 97055

1.3 Specifications

AMS 4206, AMS 4324, AMS 4336, AMS 4337 (Refs. 5–8)

1.4 Composition

1.4.1 *[Table]* Composition

1.5 Heat Treatment

Temper T7751 (for plate) defines a solution heat-treated, stress-relieved and overaged condition. Solution heat treatment is accomplished by heat-

	Al
8.0	Zn
2.3	Cu
2.0	Mg
0.16	Zr

percent). The over-aging treatment is not defined. (Ref. 5)

Temper T77511 (for extruded profiles) also defines a solution heat-treated, stress-relieved and overaged condition. Solution heat treating consists of heating at 870 to 890F for a time commensurate with product thickness, followed by rapid cooling in a suitable quenching medium. The stress relief is as described above for T7751. The overaging treatment is not defined. (Ref. 8)

Temper T76511 (for extruded rod, bar and profiles) also defines a solution heat-treated, stress-relieved and overaged condition. The solution heat treatment is undefined; the stress relief treatment is as described above for T7751. Over-aging heat treatment consists of heating at 240 to 250F for 4 to 6 hours followed by additional heating at 310 to 320F for 6.5 to 7.5 hours and air cooling. (Ref. 7)

Temper T77 has also been described as consisting of aging for 40 hours at 250F plus 0.5 hour at 360F plus another 24 hours at 250F. These aging treatments were conducted on cast, homogenized and hot-rolled strip which had been solution annealed for 1 hour at 890F. (Ref. 9)

Peak hardness is achieved in wrought strip after annealing at 30–40 hours at 250F, as shown in Fig. 1.6.1.

Additional details on heat treatment conditions are proprietary to the manufacturer.

1.6 Hardness

1.6.1 *[Figure]* Effects of aging time and silver content on hardness of wrought and annealed strip

1.7 Forms and Conditions Available

Alloy 7055 is available in rolled plate and extruded forms. A sheet product is under development as of this writing.

Plate is normally supplied in the T7751 condition. Extrusions are most commonly supplied in the T77511 condition but are also available in T76511 and T74511 conditions. Extrusions are also avail-

All chapters are organized in the same manner, with same sections i.e. Composition Section will always be 1.4

Clicking on reference will take user to list at end of chapter

Complete list of references for data in chapter

References

1. Warren, C. J., Brouwer, P. P., Garratt, M., Moran, J. P., Zonker, H. R., and Egbert, M. W., "Alcoa Alloy 7055 Plate and Extrusions," Alcoa Green Letter, Alcoa Technical Center, Product Design and Development, Alcoa Center, PA, June 23, 2003.
2. Anon., "NCEMT Meets TACOM Design Requirements for Advanced Metallic Army Bridge," *Metalworking Technology Update* (Fall 2002), pp. 2–3.
3. Lovatt, M., "Alcoa Aims at Markets in the Sky—and on the Road," *Metal Bulletin Monthly*, Vol. 252 (December 1991), pp. 17–21.
4. Srivatsan, T. S., Anand, S., Sriram, S., and Narendra, N., "The High Cycle Fatigue and Fracture Behavior of Aluminum Alloy 7055," *High Cycle Fatigue of Structural Materials*, W. O. Soboyejo and T. S. Srivatsan, Editors, The Minerals, Metals, and Materials Society (1997), pp. 381–407.
5. SAE/AMS 4206, "Aluminum Alloy, Plate (7055-T7751), 8.0Zn - 2.3Cu - 2.0Mg - 0.16Zr, Solution Heat Treated, Stress Relieved, and Overaged," Society of Automotive Engineers, January 1999.
6. SAE/AMS 4324, "Aluminum Alloy, Extruded Rod, Bar, an Profiles (7055-T74511), 8.0Zn - 2.3Cu - 2.0Mg - 0.16Zr, Solution Heat Treated, Stress Relieved, and Overaged," Society of Automotive Engineers, August 2002.
7. SAE/AMS 4336A, "Aluminum Alloy, Extruded Rod, Bar, an Profiles (7055-T76511), 8.0Zn - 2.3Cu - 2.0 Mg - 0.16Zr, Solution Heat Treated, Stress Relieved, and Overaged," Society of Automotive Engineers, June 2003.
8. SAE/AMS 4337, "Aluminum Alloy, Extruded Profiles (7055-T77511), 8.0Zn - 2.3Cu - 2.0Mg - 0.16Zr, Solution Heat Treated, Stress Relieved, and Overaged," Society of Automotive Engineers, November 1998.
9. Lee, C. W., Chung, Y. H., Cho, K. K., and Shin, M. C., "The Effect of Silver Addition on 7055 Al Alloy," *Materials & Design*, Vol. 18, Nos. 4/6 (1997), pp. 327-32.
10. Mondal, C., and Mukhopadhyay, A. K., "On the Nature of T($Al_2Mg_3Zn_3$) and S(Al_2CuMg) phases present in As-cast and Annealed 7055 Aluminum Alloy," *Matrials Science and Engineering A 391*, (2005), pp. 367–76.
11. MIL-Handbook-5J, "Section 3.7.5, 7055 Alloy," U. S. Department of Defense (January 31, 2003).
12. Ramberg, W., and Osgood, W. R., "Description of Stress-strain Curves by Three Parameters," NACA Technical Note No. 902, July 1943.
13. Kaibyshev, R., Sakai, T., Nikulin, I., Musin, F., and Goloborodko, A., "Superplasticity in a 7055 Aluminum Alloy Subjected to Intense Plastic Deformation," *Materials Science and Technology*, Vol. 19 (November 2003), pp. 1491-97.

Some data cannot be inserted into graphs. That data is found in the PDF files

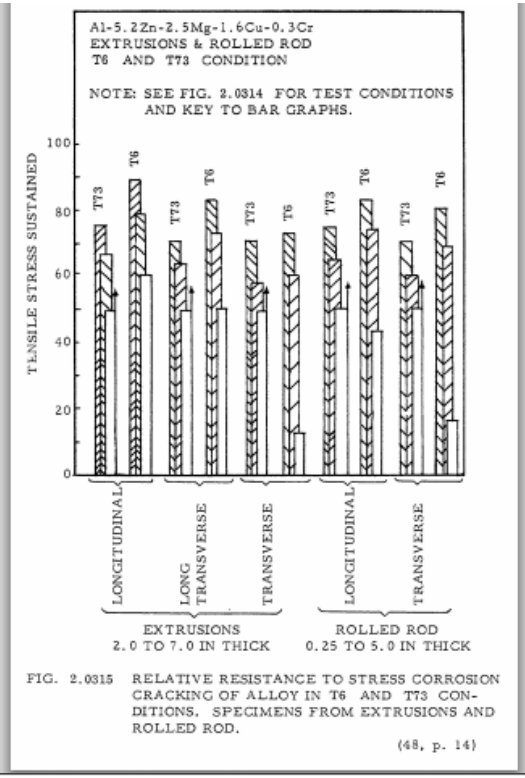


FIG. 2.0315 RELATIVE RESISTANCE TO STRESS CORROSION CRACKING OF ALLOY IN T6 AND T73 CONDITIONS. SPECIMENS FROM EXTRUSIONS AND ROLLED ROD.

(48, p. 14)

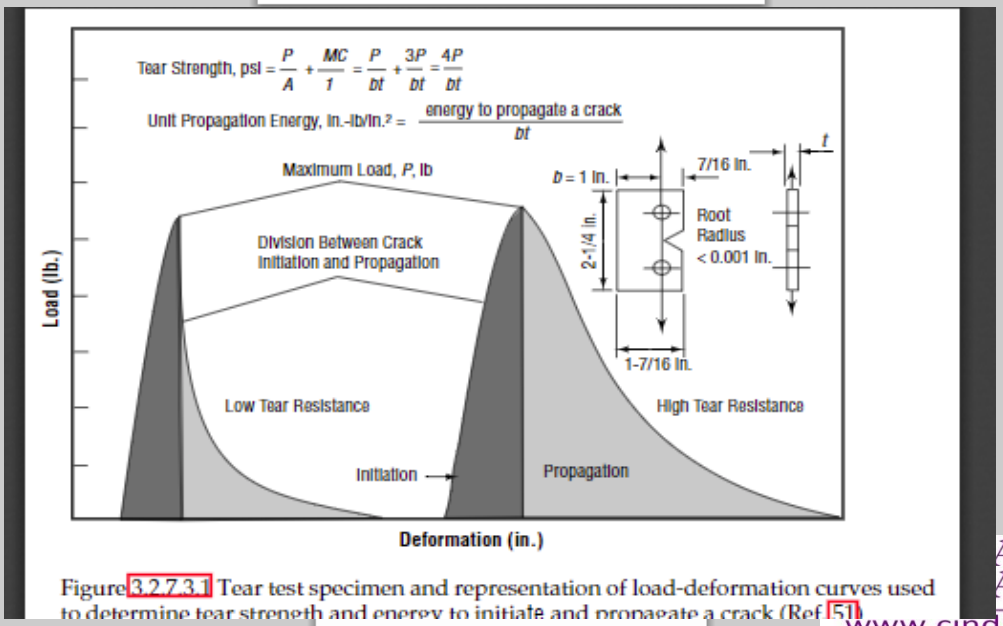


Figure 3.2.7.3.1 Tear test specimen and representation of load-deformation curves used to determine tear strength and energy to initiate and propagate a crack (Ref 51)

Microstructures and Other Photographs can be Found in the PDF Chapters for Each Alloy

Annealed condition, sheet

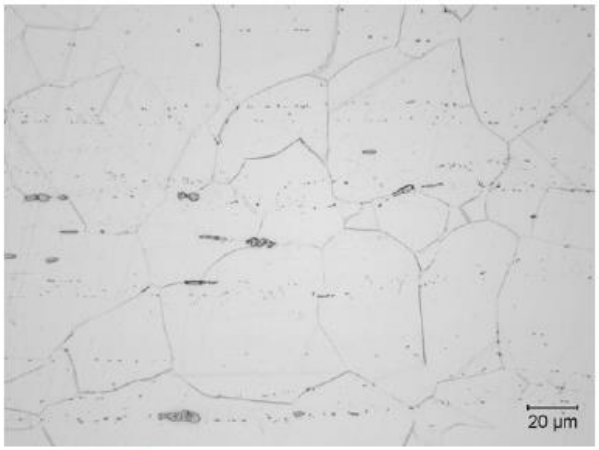


Figure 2.1.2.2 Microstructure of HAYNES 263 sheet in the annealed condition

Aged condition, plate

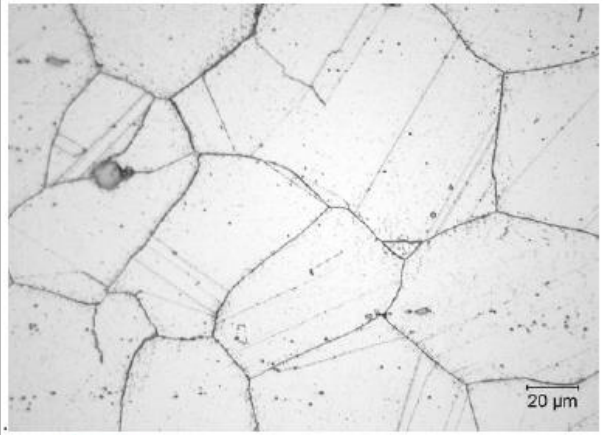


Figure 2.1.2.3 Microstructure of HAYNES 263 thin plate in the aged condition

Questions?

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- Questions can always be sent to us. We welcome your comments
  - info@cindasdata.com or
  - joan@cindasdata.com or
  - patti@cindasdata.com