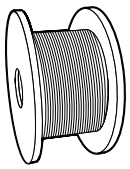
WIRELINES | SLICKLINES
ZAPP 25-6MO (UNS NO89269)

ZAPP QUALITY SYSTEM CERTIFIED TO ISO 9001:2015



ZAPP 25-6Mo (UNS NO8926) wire for

- Armoring applications on electromechanical cables
- Wirelines/ Slicklines for down hole service applications
- Shaping/shaped wire for down hole well screens

Characteristics

ZAPP 25-6MO (UNS NO8926) is a "super austenitic" stainless steel offering excellent corrosion resistance in a wide variety of aggressive, aqueous environments. It contains about 6% molybdenum, which along with higher levels of chromium and nickel, readily enables it to replace the conventional austenitic steels such as Type 316 and Type 317. It also represents a cost-effective alternative to the higher nickel alloys in some marine, petroleum, and chemical processing environments.

The alloy offers excellent resistance to pitting and crevice corrosion. Performance in these areas is often measured using Critical Pitting Temperatures (CPT), Critical Crevice Temperatures (CCT), and Pitting Resistance Equivalent Numbers (PREN). Data* is available to show superior values for ZAPP 25-6MO compared to AISI 316, AISI 317, alloy 904L, and ZAPP 2205.
ASTM Standard Test Methods G 48 is also referenced. It covers the procedures for the determination of the resistance of various alloys to pitting and crevice corrosion.

* Reference: Inco Alloys International publication number IAI-46-3, (INCO alloy 25-6MO) dated 1994.

For Comparison Purposes, PREN and CPT Numbers are Presented for These Alloys

PREN and CPT Numbers*

Alloy	PREN	CPT (°F)	CPT (°C)
ZAPP 316	26	72	22
ZAPP2205	36	108	42
ZAPP XM19	38	106	41
ZAPP2507	41	143	61
ZAPP 28	40	129	54
ZAPP 25-6MO	47	149	65
ZAPP 27-7MO	56	176	80
ZAPP MP35N	53	183	84
ZAPP C276	68	>302	>150

*PREN = Cr + 3.3 Mo + 30N

*CPT (°C) = 2.5 Cr + 7.6 Mo + 31.9 N – 41

Chemistry Standards

- UNS N08926,
- Alloy No. 1.4529,
- ASTM A580
- ASTM B649

Limiting Chemical Composition of Alloy ZAPP 25-6Mo

Ni	Cr	Mo	Cu	N	C	Mn	S	P	Si	Fe
24.0 - 26.0	19.0 – 21.0	6.0 – 7.0	0.5 – 1.5	0.15 – 0.25	0.02 max	2.00 max	0.005 max.	0.030 max.	0.5 max.	remainder

The chemical balance (and especially the 25% nickel and the 0.20% nitrogen contents) provides significantly better resistance to chloride-ion stress corrosion cracking than lower nickel alloys such as AISI 317 stainless steel. This is illustrated quite well by the Copson U-Curve in the INCO publication IAI-46-3.

The ZAPP 25-6MO wire produces higher mechanical properties than ZAPP 316. Tensile strengths in the order of 210/250,000 psi are achieved through cold drawing. At these strength levels, the wire is ductile and able to successfully pass the wrap test in the as drawn condition as well as the as drawn plus exposed to temperatures as high as 400°F conditions. This wrap or bend test shows no surface cracking or failure.

Physical Properties of Alloy ZAPP 25-6MO at Room Temperature are as Follows

Density	0.290 [lb/in³] / 8.03 [g/cm³]
Melting range	2,410 – 2,550 [°F] / 1,320 – 1,400 [°C]
Specific heat	0.12 [Btu/lb·°F] / 500 [J/kg · °C]
Electrical resistivity	480 [ohm·circ mil/ft] / 0.80 [µΩ · m]
Permeability at 200 oersted (15.9 kA/m)	< 1.01 [annealed] / < 1.01 [50% cold worked]
Young´s modulus at 70 °F (21 °C)	27.27 [10³ksi] / 188.0 [GPa]
Thermal Expansion at 200 °F (100 °C)	8.42 [in/in/°F · 10^{-6}] / 15.18 [cm/cm/°C · 10^{-6}]

ZAPP 25-6MO is also identified as UNS N08926. Wire products are covered by ASTM B649. A number of other commercially available alloy designations are related to alloy ZAPP 25-6MO through the UNS N08926 designation or through published chemistry ranges. These alternate designations or trademarks include:

- INCO® alloy 25-6MO (trademark of Special Metals Corporation)
- GD31MO (trademark of Central Wire Industries)
- SUPA 75 (trademark of Central Wire Industries)
- Cronifer® 1925hMo (trademark of Krupp VDM)
- AL6XN (trademark of Allegheny Ludlum Corporation)
- Phy 4529 (trademark of Metalimphy Alloys Corporation)

Through the connecting UNS NO8926 alloy designation, ZAPP 25-6MO, SUPA 75, and GD31MO describe the same alloy and therefore have equivalent chemistries.

Zapp Technical Data

Alloy Chemistry

Alloy	UNS	C	Mn	Cr	Ni	Mo	Cu	N	Co	Ti	Fe
ZAPP 316	S31600	.08	2.0	16.0 – 18.0	10.0 – 14.0	2.0 – 3.0.	-	-	-	-	bal.
ZAPP 2205	S32205	.03	2.0	21.0 – 23.0	4.5 – 6.5	2.5 – 3.5	-	0.18	-	-	bal.
ZAPP XM19	S20910	.06	4.0 - 6.0	20.5 – 23.5	11.5 – 13.5	1.5 – 3.0	-	.20 - .40	-	-	bal.
ZAPP 2507	S32750	.03	1.2	25.0	7.0	4.0	-	.30	-	-	bal.
ZAPP 25-6MO	NO8926	.02	2.0	19.0 – 21.0	24.0 - 26.0	6.0 – 7.0	.5 – 1.5	.15 - .25	-	-	bal.
ZAPP 27-7 MO	S31277	.02	3.0	20.5 – 23.0	26.0 – 28.0	6.6 – 8.0	.5 – 1.5	.30 - .40	-	-	bal.
ZAPP MP35N	R30035	.02	0.1	19.0 – 21.0	33.0 – 37.0	9.0 – 10.5	-	-	bal.	1.0	1.0
ZAPP C276	N10276	.01	1.0	14.5 – 16.5	-	15.0 – 17.0	-	-	2.5	-	4.0 – 7.0

(Maximum values unless range specified)

Armor Wire Typical Tensile Strength Ranges (ksi)

Size	ZAPP 316	ZAPP XM19	ZAPP 25-6MO	ZAPP 27-7MO	ZAPP MP35N
.020" - .029"	230/260	250/280	245/275	255/280	275/300
.030" - .066"	225/260	245/280	240/275	255/280	275/300

Wireline Minimum Break Strength**

Size	ZAPP 316	ZAPP 2205	ZAPP XM19	ZAPP 2507	ZAPP 25-6MO	ZAPP 27-7MO	ZAPP MP35N	ZAPP C276
.082"	1150#	1345#	1215#	1345#	1175#	1300#	1300#	1280#
.092"	1500#	1690#	1540#	1690#	1500#	1650#	1690#	1615#
.108"	2000#	2240#	2200#	2240#	2150#	2250#	2300#	2210#
.125"	2700#	2945#	3000#	2975#	2800#	3000#	3100#	2935#
.140"	3300#	3540#	3540#	3694#	3480#	3670#	3725#	3680#
.150"	3750#	3975#	4065#	4150#	3950#	4155#	4240#	4205#
.160"	4225#	4425#	4625#	4665#	4350#	4650#	4825#	4785#

(** The recommended **safe working load** is 60% of minimum break strength)

Density/Corrosion

Alloy	Density (lb/in³)	Corrosion (PREN)*	CPT (°F)	CPT (°C)**
ZAPP 316	.287	26	72	22
ZAPP 2205	.278	36	108	42
ZAPP XM19	.285	38	106	41
ZAPP 2507	.281	41	144	62
ZAPP 25-6MO	.290	47	149	65
ZAPP 27-7MO	.289	56	176	80
ZAPP MP35N	.309	53	183	84
ZAPP C276	.321	68	>302	>150

* PREN = Cr + 3.3 + 30N

** CPT (°C) = 2.5 Cr + 7.6 Mo + 31.9 N - 41

Weight per Foot (lbs.) for Wirelines

Alloy	.082"	.092"	.108"	.125"	.140"	.150"	.160"
ZAPP 316	0.018	0.023	0.031	0.042	0.053	0.060	0.069
ZAPP 2205	0.018	0.022	0.031	0.041	0.052	0.059	0.068
ZAPP XM19	0.018	0.023	0.031	0.042	0.053	0.060	0.069
ZAPP 2507	0.018	0.022	0.031	0.041	0.052	0.059	0.068
ZAPP 25-6MO	0.018	0.023	0.032	0.043	0.054	0.062	0.070
ZAPP 27-7MO	0.018	0.023	0.032	0.043	0.054	0.062	0.070
ZAPP MP35N	0.020	0.025	0.034	0.046	0.057	0.066	0.075
ZAPP C276	0.018	0.022	0.031	0.041	0.052	0.059	0.068

Examples of Theoretical Acceptable Well Environments for ZAPP 25-6MO Wire*

Chlorides	Temp °F	H_2S	CO_2	Pressure (PSI)	Req. Minimum Pitting Index (PI)	ZAPP 25-6MO (PI)	ZAPP 25-6MO (PREN)
18,000 ppm	300	<1 %	1 %	5,000	31.50	43.65	47
100,000 ppm	300	<1 %	10 %	9,000	31.50	43.65	47
100,000 ppm	158	6%	82 %	3,674	40.00	43.65 **	47
100,000 ppm	325	15 %	3 %	3,100	43.00	43.65 **	47
200,000 ppm	405	225ppm	18%	12,000	35.00	43.65	47
20,000 ppm	425	20ppm	10 %	15,000	35.00	43.65	47

** Marginally acceptable

* The theoretical acceptable well environments are based on the SOCRATES software. SOCRATES is a comprehensive material selection tool for oil and gas applications that selects corrosion resistant alloys (CRA) through material evaluation based on mechanical strength parameters, heat treatment/cold work and hardness limitations. The program also evaluates the characterization of the environment in terms of operating pressure, temperature, pH, H_2S, chlorides, elemental sulfur, aeration, gas to oil ratio and water to gas ratio water cut. Stress corrosion cracking, hydrogen embrittlement cracking, sulfide stress cracking and resistance to pitting corrosion are also evaluated. The examples above are based on the environment listed and do not take into consideration the actual values of elemental sulfur, aeration, gas to oil ratio and water to gas ratio water cut.

PI= Cr + 3.3Mo + 11N + 1.5(W+Nb)

PREN = Cr + 3.3Mo + 30N

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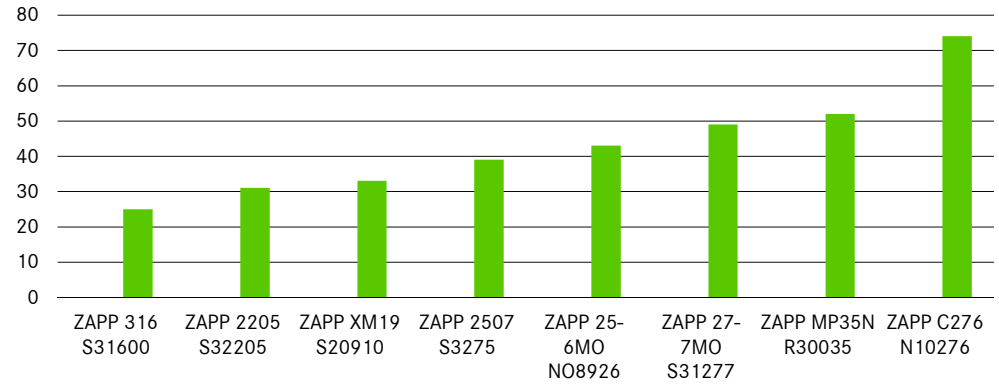
Nominal Chemical Composition Comparison

Chemical Element	ZAPP 316	ZAPP 2205	ZAPP XM19	ZAPP 2507	ZAPP 25-6MO	ZAPP 27-7MO	ZAPP MP35N	ZAPP C276
Fe	65.40	67.71	56.40	62.43	46.30	39.65	1.00	5.5
Mn	2.00	2.0	5.00	0.6	2.00	3.00	0.15	0.5
Ni	12.00	5.5	12.50	7.0	25.00	27.00	35.00	55.0 bal.
Co	*	*	*	*	*	*	32.90	2.0
Cr	17.00	22.0	22.00	25.0	20.00	21.75	20.00	15.5
Mo	2.50	2.5	2.25	4.0	6.50	7.25	9.75	16.0
W	*	*	*	*	*	*	*	*
Nb	*	*	0.20	*	*	*	*	*
N	*	0.12	0.30	*	0.20	0.35	*	*
*Trace								
PI	25.25	31.57	33.03	39.85	43.65	49.53	52.18	74.43

Pitting Index



Zapp Precision Wire Standards

1. All wirelines must pass an eddy current test as part of our NDT quality assurance program.
2. All wirelines and armor wires must pass an aged wrap test as part of our ductility quality assurance program.
3. All wirelines and armor wires have full traceability.
4. All Zapp 25-6MO wirelines and armor wires are produced using shaved, defect free rod material.

Zapp Precision Wire Quality

The Zapp Precision Wire technology, quality, and superior wire drawing capabilities will make the difference for critical armor wire and wireline applications.
The Zapp Precision Wire quality system is registered to ISO 9001:2015.

For additional information on this or any other Zapp Precision Wire product, please contact the Customer Service Department at 843-851-0700 or fax your inquiry to 843-851-0100, or e-mail the inquiry to sales@zapp.com.

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