



COMISIÓN FEDERAL
DE ELECTRICIDAD



Aluminum conductor steel-reinforced cable/steel wire core coated with welded aluminum (ACSR/AS)

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introduction

The development of the infrastructure for transmission and distribution of electrical energy requires to have high quality inputs to improve reliability and service continuity.

The main element for the transmission of electric power is the cable which has sought to improve substantially the quality of that item in the acquisitions made by CFE, with the standard or specification control means to raise standards.

The Standard Reference NRF-051-CFE-2012, "Aluminum conductor steel-reinforced cable/steel wire core coated with welded aluminum (ACSR/AS)", was considered in the National Standardization Program 2005.

This standard is intended to establish the types of constructions, characteristics and requirements to be met acsr/as with up to 603 mm² designation (ACSR/AS 1113), Which will be used in Federal Electricity Commission (CFE) transmission lines .

Previously ACSR/AS cables, were regulated by the CFE Specification E0000-18, and this was based on ASTM standards.

DEVELOPMENT OF THE STANDARD.

In the development of this standard the following manufacturers participated:

- 1. - CONDUMEX**
- 2. - VIAKON**
- 3. - GENERAL CABLE**
- 4. - IUSA**
- 5. - CONDUCTORES DEL NORTE**



TYPES OF ACSR/AS CABLES

TABLA 1 - Características generales del cable ACSR/AS

Descripción corta	Designación	Área nominal de la sección transversal (mm ²)			Conductor de aluminio		Núcleo de acero			Diámetro exterior del cable (mm)	Masa (kg/km)			Carga mínima de ruptura (kN)	Resistencia eléctrica c.d. nominal a 20 °C al cable completo Ω/km
		Aluminio	Acero	Total	Número alambres	Diámetro de los alambres (mm)	Número alambres	Diámetro de los alambres (mm)	Diámetro núcleo de acero (mm)		Aluminio	Acero	Total		
ACSR/AS 1/0	RAVEN/AS	53,48	8,97	62,45	6	3,37	1	3,37	3,37	10,11	145	59	207	19	0,506
ACSR/AS 3/0	PIGEON/AS	85,01	14,15	99,16	6	4,25	1	4,25	4,25	12,75	230	93	330	28	0,318
ACSR/AS 266	PARTRIDGE/AS	135,2	22,0	157,2	26	2,57	7	2,00	6,00	16,31	366	145	520	48	0,203
ACSR/AS 336	LINNET/AS	170,5	27,7	198,2	26	2,89	7	2,25	6,74	18,29	461	183	657	60	0,160
ACSR/AS 477	HAWK/AS	241,7	39,3	281	26	3,44	7	2,67	8,02	21,77	654	258	929	84	0,113
ACSR/AS 795	DRAKE/AS	402,8	65,6	468,4	26	4,44	7	3,45	10,36	28,11	1 089	431	1 549	136	0,068
ACSR/AS 900	CANARY/AS	456	59,1	515,1	54	3,28	7	3,28	9,84	29,52	1 234	390	1 656	138	0,061
ACSR/AS 1113	BLUE JAY/AS	564	39	603	45	4,00	7	2,66	7,99	31,98	1 526	256	1 822	130	0,050

NOTA: Las tolerancias para alambres de aluminio están con base en las normas NMX-J-027-ANCE y para alambres de acero recubiertos de aluminio soldado el Apéndice H.

TESTING HARD ALUMINUM WIRES

A.1 PRUEBAS A LOS ALAMBRES DE ALUMINIO DURO

Las pruebas que se deben realizar a los alambres de aluminio duro son las que se indican en la tabla A.1.

TABLA A.1 - Pruebas a los alambres de aluminio duro.

Prueba	Norma que aplica	Tipo de prueba		
		Prototipo	Rutina	Aceptación
Diámetro	NMX-J-066-ANCE	X	X	--
Área	NMX-J-066- ANCE	X	X	X
Resistencia y resistividad eléctrica	NMX-J-212- ANCE	X	X	X
Esfuerzo de ruptura por tensión	NMX-J-312- ANCE	X	X	X
Ductibilidad o enrollamiento	NMX-J-027- ANCE	X	X	--

NOTA: Las pruebas de rutina se aplican a los alambres antes de cablear y las pruebas de aceptación se aplican a los alambres removidos del cable.

TESTING WIRES

A.2 PRUEBAS A LOS ALAMBRES DE ACERO RECUBIERTOS DE ALUMINIO SOLDADO

Las pruebas que se deben realizar a los alambres de acero recubiertos de aluminio soldado son las que se indican en la tabla A.2.

TABLA A.2 - Pruebas a los alambres de acero recubiertos de aluminio soldado.

Prueba	Norma que aplica	Tipo de prueba		
		Prototipo	Rutina	Aceptación
Dimensiones y tolerancias	Apéndice H	X	X	X
Análisis químico	Apéndice H	X	--	--
Masa del recubrimiento de aluminio soldado	Apéndice H	X	X	X
Esfuerzo de ruptura por tensión al 1 % del alargamiento	Apéndice H	X	X	X
Tensión de ruptura	Apéndice H	X	X	X
Enrollado	Apéndice H	X	X	X
Acabado y uniones	Apéndice H	X	X	X

NOTA:

1. Las pruebas de rutina se aplican a los alambres antes de cablear y las pruebas de aceptación se aplican a los alambres removidos del cable.

A.3 PRUEBAS AL CABLE TERMINADO

Las pruebas que se deben realizar al cable terminado son las que se indican en la tabla A.3.

TABLA A.3 - Pruebas al cable terminado.

Prueba	Norma que aplica	Tipo de prueba		
		Prototipo	Rutina	Aceptación
Diámetros	Apéndice I	X	X	--
Área	Apéndice I	X	X	X
Resistencia y resistividad eléctrica	Apéndice I	X	X	X
Esfuerzo de ruptura por tensión	Apéndice I	X	X	X
Relación de paso de cableado (de cada capa)	Apéndice I	X	X	--
Sentido de cableado (de cada capa)	Apéndice I	X	X	--
Esfuerzo – deformación, Módulo de elasticidad final. (Cable completo y núcleo de acero)	Como se indica en Apéndice B, D y G.	X	--	--
CREEP (Cable completo y núcleo de acero)	Apéndice E y F	X	--	--

**TESTING
CABLE**

INTRODUCTION OF NEW TESTS

CFE have had to develop tests to improve the product and therefore had to update and improve the laboratory facilities, to achieve more efficient testing and meet the needs of customers. Two tests are the drivers of substantial modification of cables standards:

- **Creep (permanent deformation)**
- **Stress – strain**

BOTH ARE BASED ON IEC STANDARDS





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MECHANICAL LAB TESTS

THE LABORATORY OF STRESS-STRAIN SAND CREEP TESTS OF LAPEM WAS ESTABLISHED DURING THE DEVELOPMENT OF THESE TESTS AND THEIR INCLUSION IN THE STANDARD





HORIZONTAL STRAIN TEST MACHINE “MATHEO”

CAPABILITY OF 20 ton

LENGTH 20 meter

TIME OF TEST: 5 hours



**Multitension machine
“MAMUT”**

Unique in Latinoamérica



LOAD 25 ± 1 % de R.T.S.

TEMPERATURE 20 ± 2 °C

STRAIN TEST

TIME OF TEST 1000 HOURS

INFRASTRUCTURE



- 1 Load cell 20 ton**
- 3 Load cell 5 ton**
- 12 Temperature sensors with precision OF $\pm 0,5$ °C**
- 4 Strain testers**



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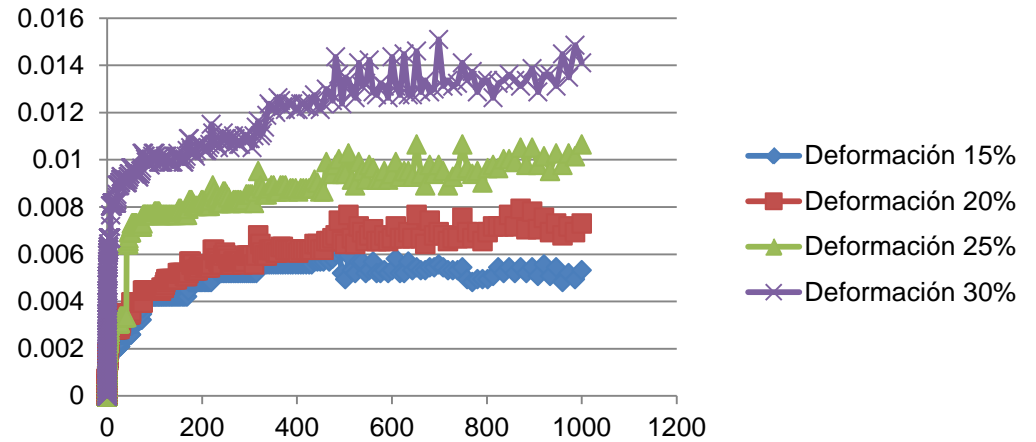


Test Program

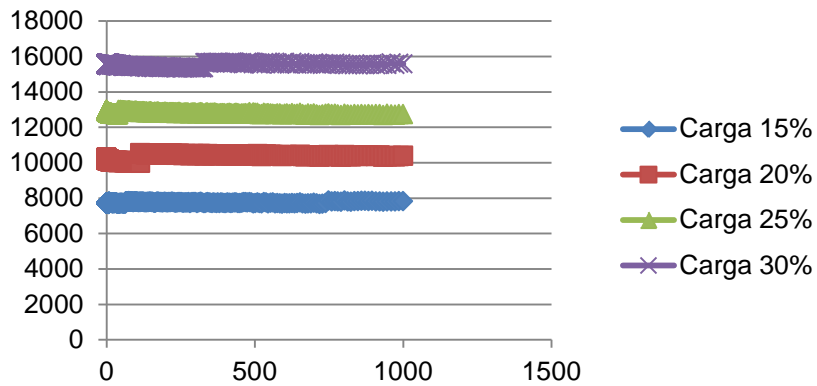
			AÑOS															
Personal	Prog	Real	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Fabricante 1	Cable	1113	█															
	Cable	795			█													
	Cable	477					█											
	Cable	336							█									
	Cable	266									█							
	Cable	3/0											█					
	Cable	1/0													█			
Fabricante 2	Cable	1113		█														
	Cable	795				█												
	Cable	477						█										
	Cable	336								█								
	Cable	266										█						
	Cable	3/0												█				
	Cable	1/0														█		

Period: 1000 hrs

STRAIN (%)



LOAD (N)



Carga	Muestra	1h	10h	100h	1000h	8760h	87600h	a	b
15%	1	0.004	0.005	0.009	0.014	0.021	0.032	0.003515	0.195304
	2	0.001	0.002	0.005	0.007	0.014	0.028	0.001036	0.292383
	3	0.001	0.002	0.005	0.009	0.017	0.033	0.00135	0.281051





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Test Results

CFE E0000-18-2011 specification was considered during the development of this standard, in order to apply it in the tenders in process during this period, and continue the process of accreditation of prototype cables suppliers participating in the preparation of the reference standard, in this process all manufacturers took the stress-strain test, pending the creep test.

The stress-strain and creep diagrams are used as input data in design of transmission lines, previously the mechanical behavior of the cable, used to be considered linear (modulus of elasticity), but with the application of digital programs, it is necessary to have these diagrams




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Adapted from 1970's Publicly Available Data

Descripción	Área de la sección transversal [mm ²]	Diámetro exterior [mm]	Peso unitario [daN/m]	Tensión última [daN]	Número de alambres independientes	Temperatura a la cual se obtuvo la información [°C]	Hilos de Aluminio		Coeficientes del polinomio (deformación en %, esfuerzo en daN/mm ²)					Hilos de acero		Coeficientes del polinomio (deformación en %, esfuerzo en daN/mm ²)					Propiedades de régimen térmico				
							Modulo de elasticidad final [daN/mm ² /100]	Coefficiente de dilatación térmica [/'100°]	a0	a1	a2	a3	a4	Modulo de elasticidad final [daN/mm ² /100]	Coefficiente de dilatación térmica [/'100°]	b0	b1	b2	b3	b4	Resistencia de AC (25°C)	Coefficiente de emisividad	Coefficiente de absorción solar	Capacidad térmica de los hilos de Al [Watt-s/m ² -C]	Capacidad térmica del núcleo [Watt-s/m ² -C]
1113 kcmil 45/7 hilos ACSR AW	603.225	31.9786	1.78629	13033	1	22.7778	52.4001	0.002304	-0.69802	44.1581	-35.0037	-19.094	27.0343	11.9969	0.001152	0.077428	-10.3075	10.1964	-22.8444	10.7937	0.052692	0.5	0.5	1489.81	123.024
900 kcmil 54/7 hilos ACSR AW	515.096	29.5148	1.62138	14190	1	21.1111	44.1264	0.002304	-0.32585	36.5227	-35.8214	9.45959	4.23199	21.7184	0.001152	0.095285	19.6405	11.1231	-36.2491	19.8941	0.063007	0.5	0.5	1204.27	186.307
795 kcmil 26/7 hilos ACSR AW	468.644	28.1432	1.52068	13567	1	21.1111	44.1264	0.002304	-0.83633	30.5493	-9.65568	-25.937	21.1503	25.5106	0.001152	-0.04778	26.6337	2.75659	-31.5179	19.2308	0.070215	0.5	0.5	1064.19	206.717
477 kcmil 26/7 hilos ACSR AW	280.903	21.7932	0.91124	8407.1	1	23.8889	47.229	0.002304	-0.60874	40.5326	-41.6354	4.52157	11.5156	27.286	0.001152	-0.01634	27.9678	-3.03686	-10.7075	4.80977	0.116072	0.5	0.5	637.86	123.945
336.4 kcmil 26/7 hilos ACSR AW	198.064	18.288	0.64286	6005.1	1	23.8889	47.229	0.002304	-0.60874	40.5326	-41.6354	4.52157	11.5156	27.286	0.001152	-0.01634	27.9678	-3.03686	-10.7075	4.80977	0.164166	0.5	0.5	449.771	87.378
266.8 kcmil 26/7 hilos ACSR AW	157.161	16.3068	0.5102	4804.1	1	23.8889	47.229	0.002304	-0.60874	40.5326	-41.6354	4.52157	11.5156	27.286	0.001152	-0.01634	27.9678	-3.03686	-10.7075	4.80977	0.202629	0.5	0.5	357.004	69.378
1 /O AWG 6/1 hilos ACSR AW	62.4515	10.1092	0.20169	1890.5	1	23.8889	50.4695	0.002304	-0.42892	43.6182	-50.0212	20.6339		27.7858	0.001152	0.006412	26.5914	1.29794	-17.643	10.5552	0.516297	0.5	0.5	139.932	27.9921
3 /O AWG 6/1 hilos ACSR AW	99.1611	12.7508	0.32019	2802.4	1	23.8889	50.4695	0.002304	-0.42892	43.6182	-50.0212	20.6339		27.7858	0.001152	0.006412	26.5914	1.29794	-17.643	10.5552	0.325039	0.5	0.5	222.187	44.4331



The Aluminum Association

900 19th Street, N.W.
Washington, D.C. 20006



STRESS-STRAIN-CREEP CURVE FOR ALUMINUM CONDUCTORS



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IUSA S.A. DE C.V.

CABLE ACSR/AS 1113 kcmil BLUE JAY

MUESTRA 1			MUESTRA 2			MUESTRA 3			PROMEDIOS		Corrección de datos	
% RTS	N	DEFORMACION (%)	% RTS	N	DEFORMACION (%)	% RTS	N	DEFORMACION (%)	DEFORMACION (%)	Tensión mecánica N	Factor de corrección	Deformación ajustada
0	0	0.000	0	0	0.000	0	0	0.000	0.000	0.000	-0.004	0
5	6500	0.00	5	6500	0.000	5	6500	0.000	0.000	6500		0.02
15	19500	0.070	15	19500	0.080	15	19500	0.100	0.083	19500		0.087
30	39000	0.150	30	39000	0.160	30	39000	0.180	0.163	39000		0.167
50	65000	0.270	50	65000	0.280	50	65000	0.290	0.280	65000		0.284
70	91000	0.440	70	91000	0.430	70	91000	0.440	0.437	91000		0.441
85	110500	0.550	85	110500	0.600	85	110500	0.600	0.583	110500		0.587
RTU	138120			139850			136630			138985		
RTS	13000											
Real	0											

GRAFICO 1.- ESFUERZO - DEFORMACION PARA EL CABLE ACSR/AS 1113 kcmil BLUE JAY

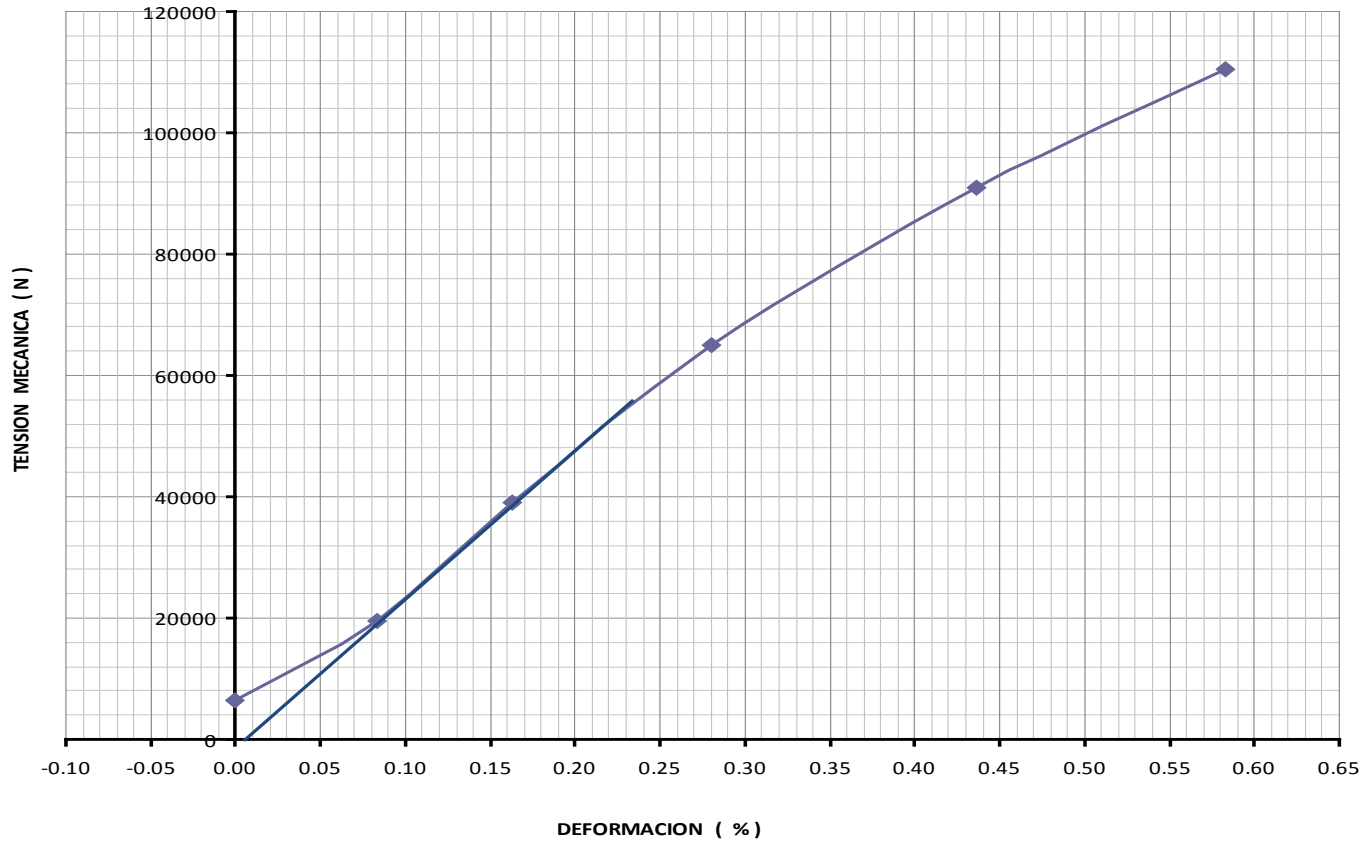


GRAFICO. 2 ESFUERZO- DEFORMACION AJUSTADA PARA CABLE ACSR/AS 1113 kcmil BLE JAY

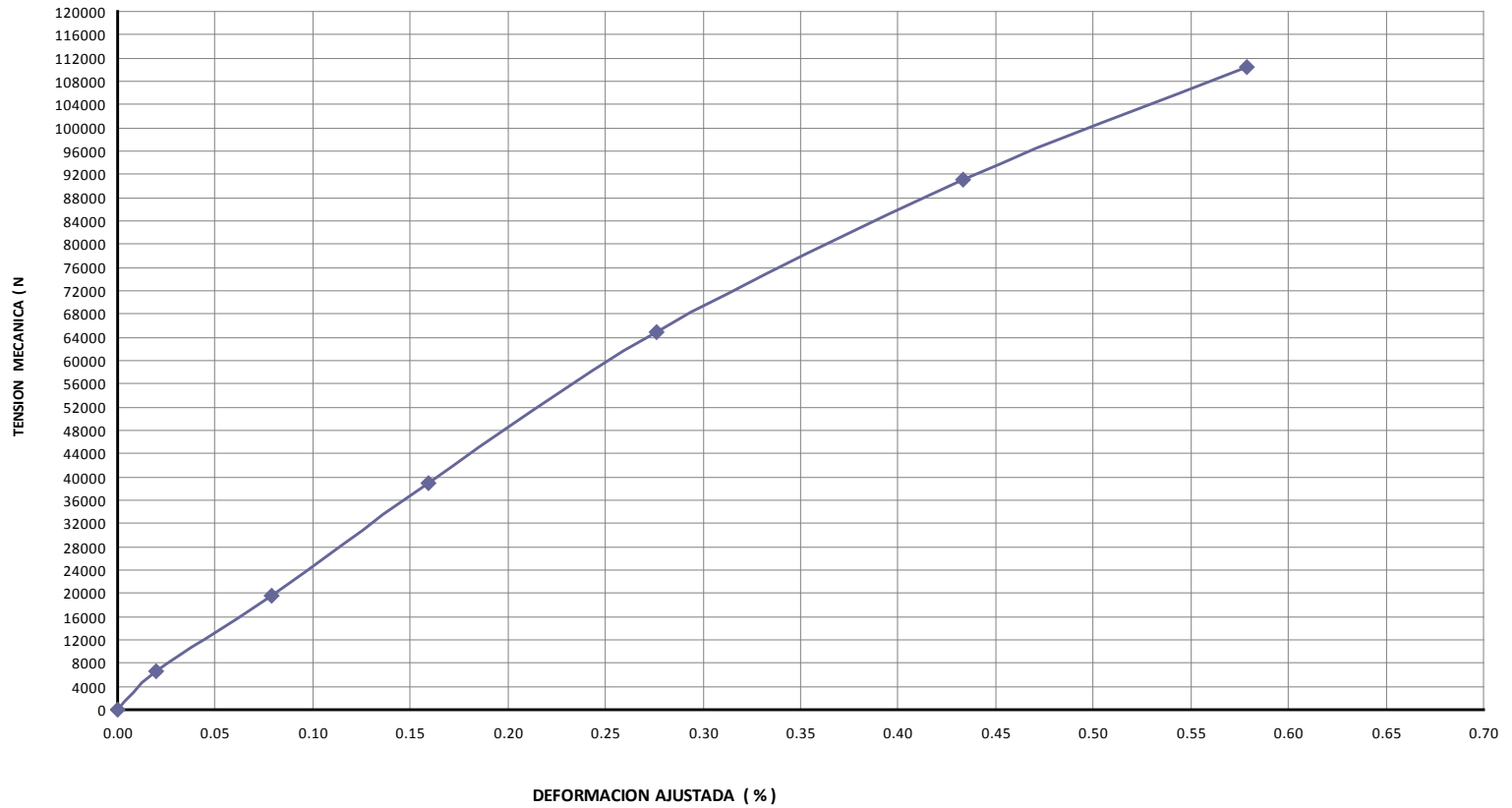
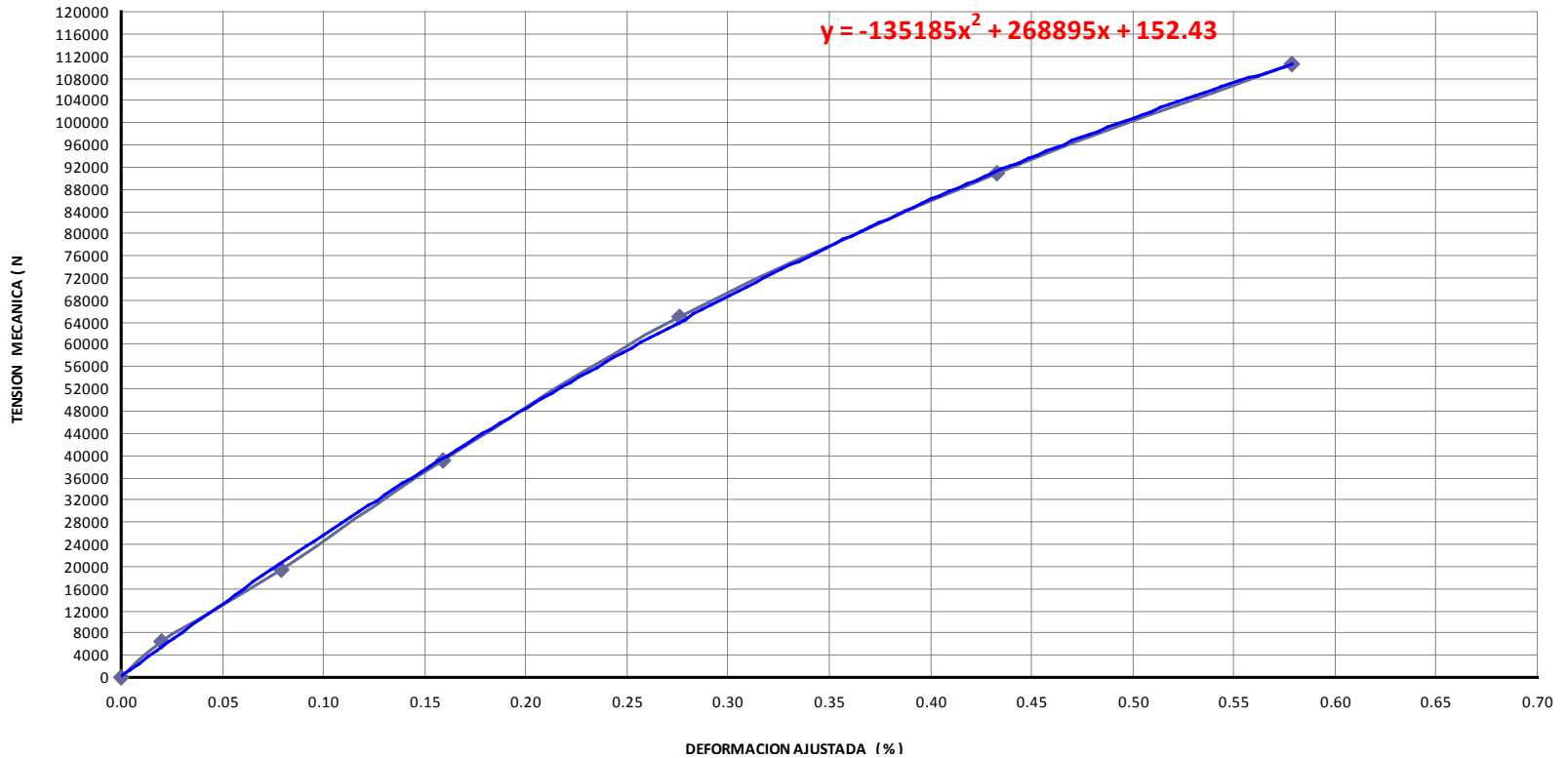


GRAFICO. 3 ESFUERZO- DEFORMACION AJUSTADA PARA CABLE ACSR/AS 1113 kcmil BLE JAY





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NUCLEO DEL CABLE ACSR/AS 1113 kcmil BLUE JAY

MUESTRA 1			MUESTRA 2			PROMEDIOS		Corrección de datos	
% RTS	N	DEFORMACION (%)	% RTS	N	DEFORMACION (%)	DEFORMACION (%)	Tensión mecánica a N	Factor de corrección	Deformación ajustada
0	0	0.000	0	0	0.000	0.000	0.000	0.024	0
5	2510	0.000	5	2510	0.000	0.000	2510		0.024
15	7530	0.100	15	7530	0.108	0.1040	7530		0.1358
30	15060	0.227	30	15060	0.233	0.2300	15060		0.2828
50	25100	0.414	50	25100	0.421	0.4175	25100		0.4998
70	35140	0.645	70	35140	0.655	0.6500	35140		0.7583
85	42670	0.883	85	42670	0.890	0.8865	42670		1.0156
RTU	51390			52100					
RTS Real	50200								

GRAFICO 4.- ESFUERZO - DEFORMACION PARA NUCLEO ACSR/ AS 1113 kcmil BLUE JAY

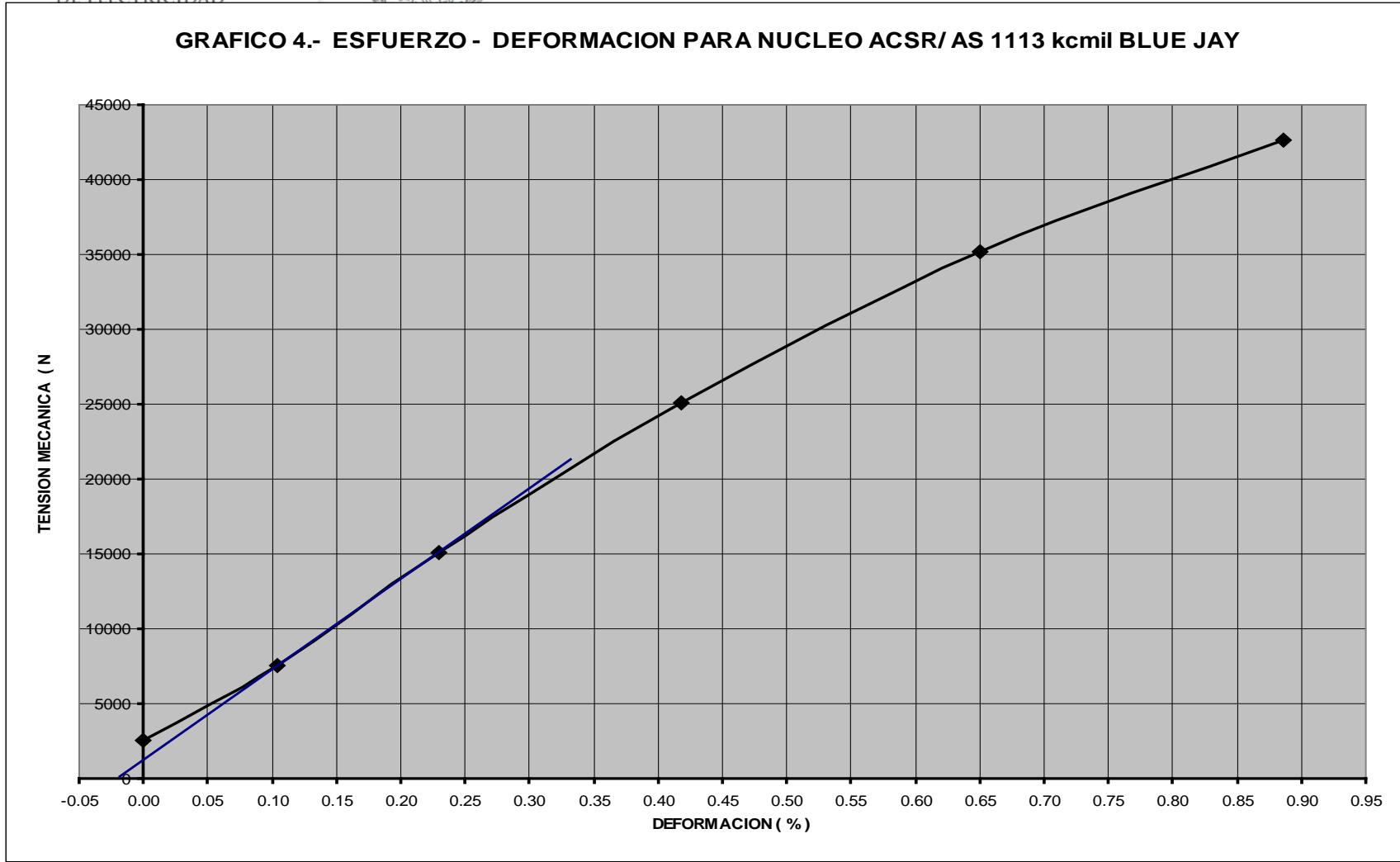


GRAFICO 5.- ESFUERZO- DEFORMACION AJUSTADA DEL NUCLEO ACSR/AS 1113 kcmil BLUE JAY

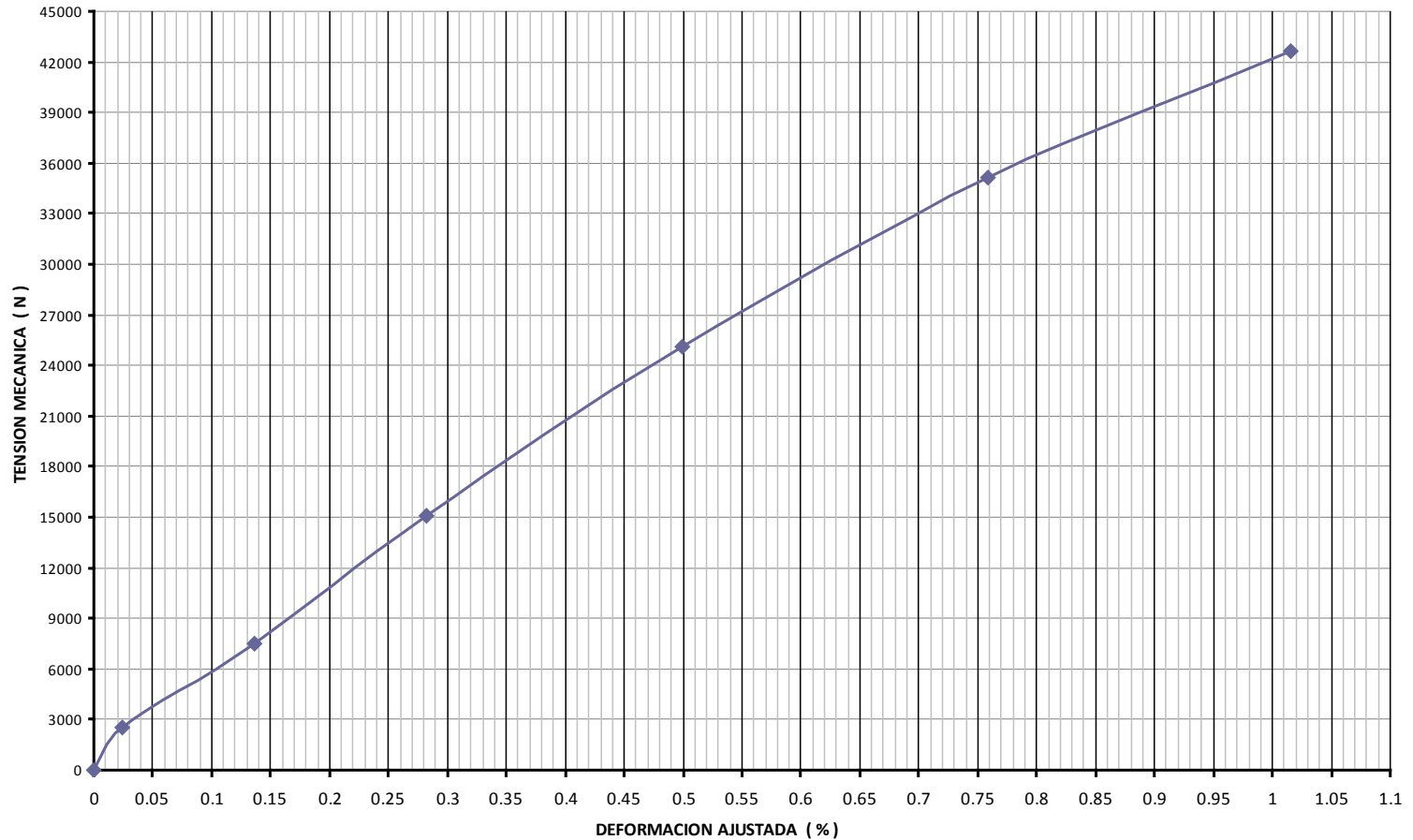
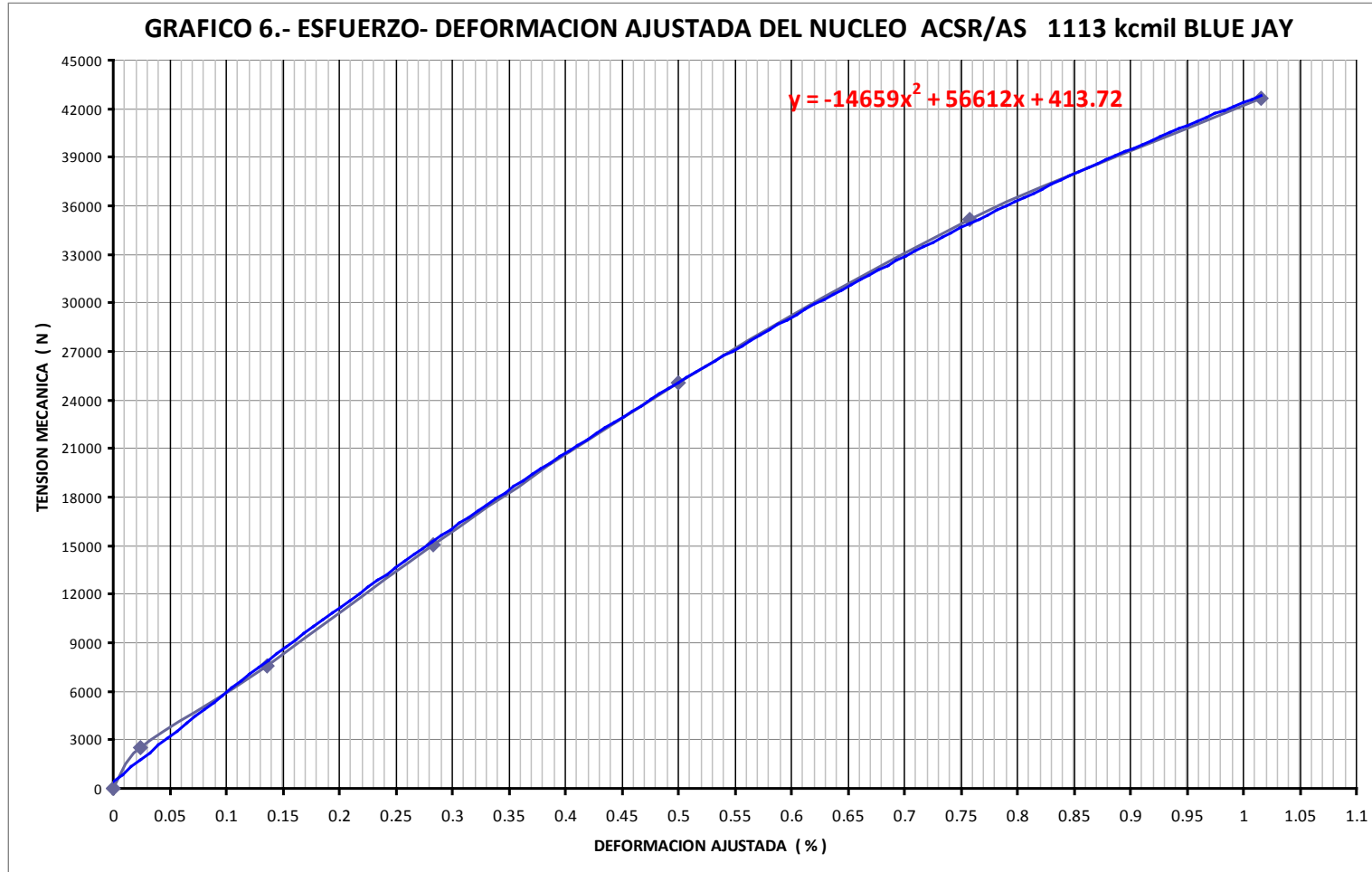


GRAFICO 6.- ESFUERZO- DEFORMACION AJUSTADA DEL NUCLEO ACSR/AS 1113 kcmil BLUE JAY





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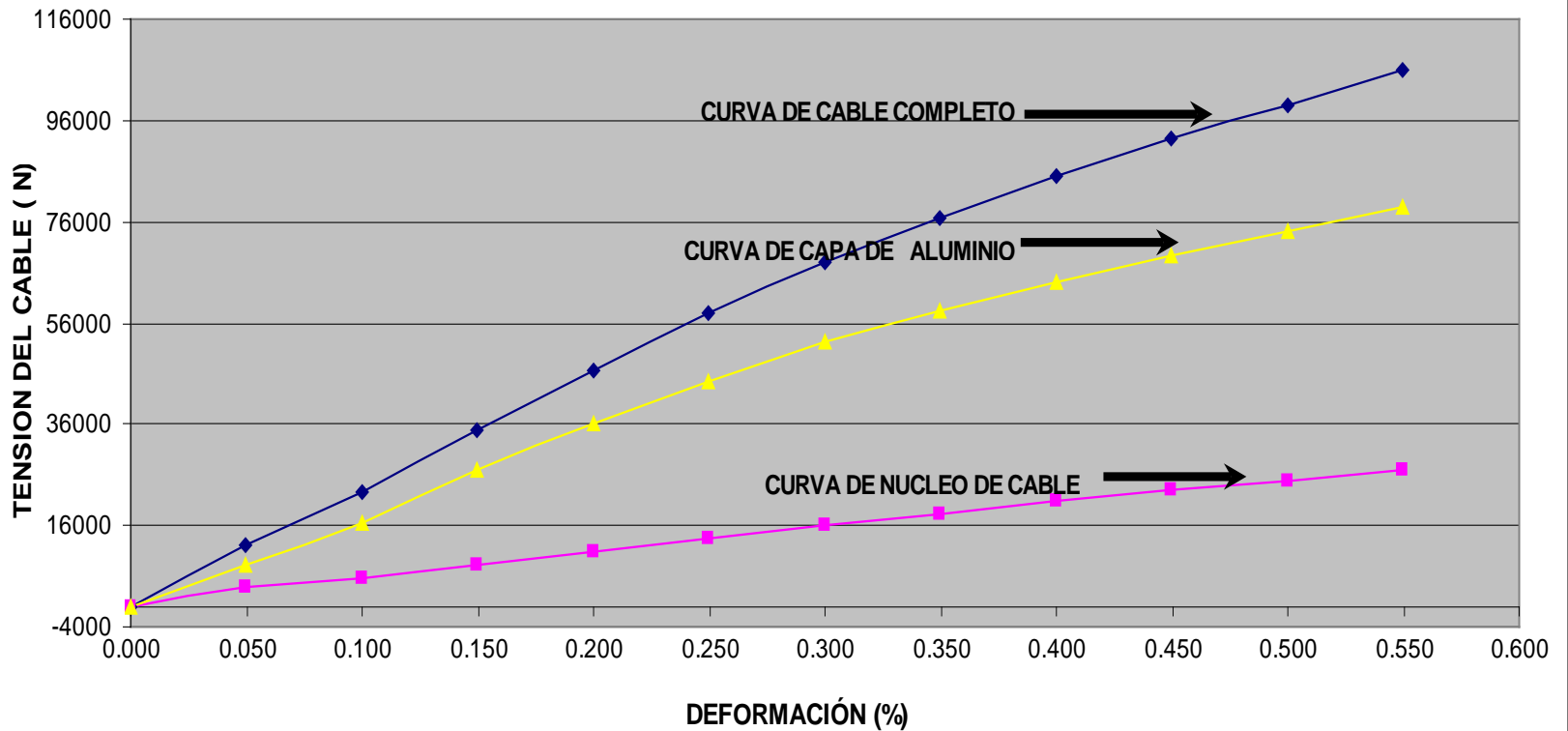
**TABLA DE DATOS PARA GRAFICA FINAL DE ESFUERZO – DEFORMACION DEL
CABLE ACSR/AS 1113 kcmil BLUE JAY**

DEFORMACIÓN (%)	TENSION CABLE (N)	TENSION NUCLEO (N)	TENSION ALUMINIO (N)
0.000	0	0	0
0.050	12200	3800	8400
0.100	22500	5800	16700
0.150	35000	8100	26900
0.200	46800	10800	36000
0.250	58000	13500	44500
0.300	68000	15900	52100
0.350	76900	18300	58600
0.400	84900	20700	64200
0.450	92300	23000	69300
0.500	99200	25000	74200
0.550	105900	27200	78700

$$y = -135185x^2 + 268895x + 152.43 \text{ ECUATION CABLE}$$

$$y = -14659x^2 + 56612x + 413.72 \text{ ECUATION CORE}$$

GRAFICO FINAL DE ESFUERZO - DEFORMACION DEL CABLE ACSR/AS 1113 kcmil BLUE JAY





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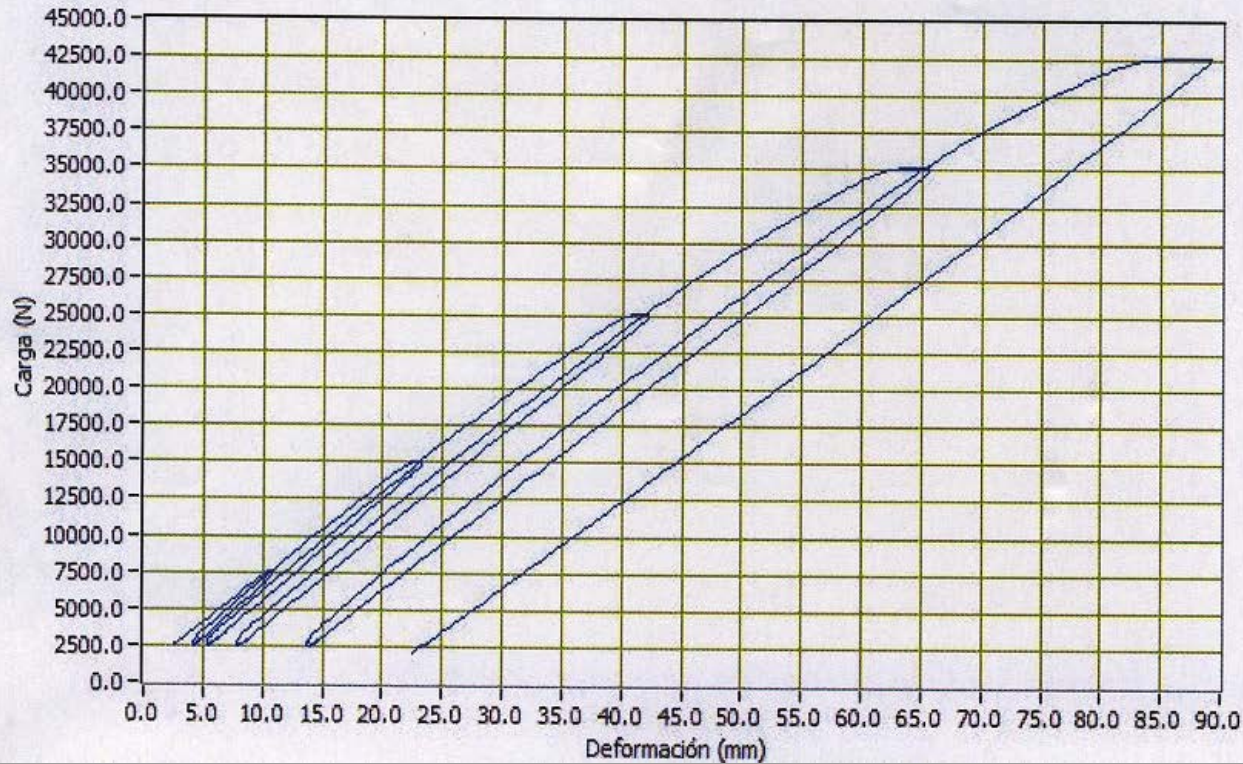


IUSA S.A. DE C.V. modulo de elasticidad núcleo 1113 kcmil acsr/as

CFE *Una empresa
de clase mundial*

Prueba de Tensión

LAPEM
VITALIDAD E INNOVACIÓN



Hoja 8 de 9



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IUSA S.A. DE C.V. modulo de elasticidad núcleo 1113 kcmil acsr/as

Determinación del Módulo de Elasticidad Final del Núcleo

Tomando valores de (x1, y1) y (x2, y2) en la curva de la grafica Carga-Deformación al 70% tenemos lo siguiente

x1	31	mm	0.31 %		
y1	12500	N			
x2	62	mm	0.62 %	Módulo de Elasticidad Final Núcleo	
y2	32500	N		MEFN=	1633.32 N/mm2

Calculando el coeficiente angular de los dos puntos

$$m = 64516.13 \text{ N/mm}$$

$$b = -7500 \text{ N}$$

$$MEFC = 552.79$$

$$meInplscadd = 10.68 \text{ daN/mm}^2/100$$

$$\text{Ecuación } Y = 58823.5294 * x - 4705.88235$$

	Sección transversal	Relación
Valor Calculado	Nucleo Blue Jay	39.5 mm ²
Valor Calculado	Al Blue Jay	564.7 mm ²
	Cable completo	604.2 mm²

$$MEFC = MEFAL * \text{Rel. Al} + MEFN * \text{Rel. Núcleo}$$

$$MEFAL = (MEFC - MEFN * \text{Rel. Núcleo}) / \text{Rel. Al}$$

$$MEFAL = 477.21 \text{ N/mm}^2$$

$$47.72 \text{ daN/mm}^2$$

$$mecplscadd = 44.6 \text{ daN/mm}^2/100$$



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IUSA S.A. DE C.V. modulo de elasticidad núcleo 1113 kcmil acsr/as

VALORES DE MODULO DE ELASTICIDAD DEL NUCLEO DE ALAMBRES DE ACERO RECUBIERTOS DE ALUMINIO EMPLEADOS EN LOS CONDUCTORES ACSR/AS

	BLUE JAY		CANARY		DRAKE		HAWK		LINNET		PARTRIDGE		PIGEON		RAVEN	
PROVEEDOR	dN/mm ² /100	dN/mm ²	dN/mm ² /100	dN/mm ²	dN/mm ² /100	dN/mm ²	dN/mm ² /100	dN/mm ²	dN/mm ² /100	Dn/mm ²	dN/mm ² /100	Dn/mm ²	dN/mm ² /100	Dn/mm ²	dN/mm ² /100	Dn/mm ²
CONDUCTORES DEL NORTE	9.97	1543.81	21.54	1877.94	22.30	1592.86	22.59	1842.58								
CONDUMEX	10.32	1597.52	21.54	1877.94	21.80	1557.14	19.48	1588.91	23.26	1663.81	21.51	1536.43	23.86	1670.87	21.67	1516.45
CX Ajustado Valor Mínimo						1609.00										
IUSA	10.67	1651.24	21.17	1845.68	22.63	1616.43	25.69	1846.93	23.54	1683.83	22.34	1595.71	24.24	1697.48	23.72	1659.90
VIKON	9.76	1510.06			21.33	1524.26	22.97	1873.65							21.93	1534.64
GENERAL CABLE	10.22	1582.59	22.25	1939.49	22.25	1588.99	22.25	1814.51	22.25	1591.27	22.25	1588.99	22.52	1576.69	22.52	1575.59
PLS_CADD	11.9969	1857.105263	21.7184	1893.496077	25.5506	1825.042857	27.286	2225.611746	27.286	1951.788269	27.286	1949	27.7858	1945.784314	27.7858	1944.422673
MEF Nominal		1600		1870		1600		1830		1600		1600		1600		1600
		0.985		0.985		0.985		0.985		0.985		0.985		0.985		0.985
LÍMITE MÍN. ACEPTABLE (dN/mm ²)		1576	0	1841.95	0	1576	0	1802.55	0	1576	0	1576	0	1576	0	1576
Diametro maximo del alambre individ. (mm)				3.31				2.72		2.288		2.03		4.314		
diámetro alambre AW (mm)		2.66		3.28		3.45		2.68		2.25		2		4.25		3.37
Diámetro Mín. alambre AW (mm)		2.62		3.25		3.398		2.64		2.212		1.97		4.186		3.319
No. Alambres núcleo		7		7		7		7		7		7		1		1
Área nominal núcleo (mm ²)		38.90		59.15		65.44		39.49		27.83		21.99		14.19		8.92
Área mínima núcleo (mm ²)		37.74		58.07		63.48		38.32		26.90		21.34		13.76		8.65
NOTA		1		1		2		2		1		2		1		2
						Valor fuera de norma										
NOTA 1	INCLUIR EN EL REPORTE															
	MARCAS DEL PROVEEDOR															
	DIÁMETROS ALAMBRES INDIVIDUALES															
NOTA 2	ENSAYO ESFUERZO-DEF NÚCLEO															
	PRUEBAS DE ACUERDO A A 0000-01-2012															



COMISIÓN FEDERAL
DE ELECTRICIDAD



CONDUCTORES DEL NORTE

CONDUCTORES DEL NORTE

Polinomy 1113 kcmil acsr/as

Cable Data

Cable Model

- Nonlinear cable model (separate polynomials for initial and creep behavior for inner and outer materials)
- Linear elastic with permanent stretch due to creep proportional to creep weather case tension
- Linear elastic with permanent stretch due to creep specified as a user input temperature increase

Name: c:\users\jaramos\documents\2011 proyectos\m10. simulación mecánica de líneas de transmisión aérea\cfe\cfe 19oct11 cdni\l

Description: Bluejay M23 CdNI 190ct11

Stock Number: CND051SCK

Cross section area (mm²): 610.174 Unit weight (daN/m): 1.8496

Outside diameter (mm): 31.992 Ultimate tension (daN): 14740.3

Number of independent wires (1 unless messenger supporting other wires with a spacer): 1

Conductor is a J-Power Systems GAP type conductor strung with core supporting all tension.

Temperature at which strand data below obtained (deg C): 22.7778

Outer Strands

Final modulus of elasticity (see note below)(daN/mm²/100): 45.3057

Thermal expansion coeff. (/100 deg): 0.002304

Polynomial coefficients (all strains in %, stresses in daN/mm², see a0 a1 a2 a3 a4)

Stress-strain	0.04040	43.2939	-56.9146	65.7576	-47.343E
	c0	c1	c2	c3	c4
Creep	0.04040	43.2939	-56.9146	65.7576	-47.343E

Note: Final modulus, stress-strain and creep are actual material values multiplied by ratio of outer strand area to total area.

Core Strands (if different from outer strands)

Final modulus of elasticity (see note below)(daN/mm²/100): 9.97349

Thermal expansion coeff. (/100 deg): 0.001152

Polynomial coefficients (all strains in %, stresses in daN/mm², see b0 b1 b2 b3 b4)

Stress-strain	-0.02873	10.1776	-3.3984E	2.42948	-1.7467
	d0	d1	d2	d3	d4
Creep	-0.02873	10.1776	-3.3984E	2.42948	-1.7467

Note: Final modulus, stress-strain and creep are actual material values multiplied by ratio of core strand area to total area.

Bimetallic Conductor Model...

Aluminum has a larger thermal expansion coefficient than steel. If Aluminum is used as the outer material over a steel core there is a temperature transition point at which the aluminum is no longer under tension.

Select the behavior you want for temperatures above the transition point

- Use behavior from Criteria/Bimetallic Conductor Model
- Aluminum does not take compression at high temperature (Bird Cage)
- Aluminum can go into compression at high temperature

VirtualStress = ActualStress * Ao / At
 Ao = cross section area of outer strands
 At = total cross section area of entire conductor (outer + inner strands)

Maximum virtual compressive stress (MPa): 0

Thermal Rating Properties

Resistance at two different temperatures

Resistance (Ohm/km)	0.0526923	at (deg C)	25
Resistance (Ohm/km)	0.0628828	at (deg C)	75

Emissivity coefficient: 0.5

Solar absorption coefficient: 0.5

Outer strands heat capacity (Watt-s/m-deg C): 1498.81

Core heat capacity (Watt-s/m-deg C): 123.024

Buttons: Generate Coefficients from points on stress-strain curve Composite cable properties OK Cancel



COMISIÓN FEDERAL
DE ELECTRICIDAD



CONDUMEX

Polinomy 1113 kcmil acsr/as

Cable Data

Cable Model

- Nonlinear cable model (separate polynomials for initial and creep behavior for inner and outer materials)
- Linear elastic with permanent stretch due to creep proportional to creep weather case tension
- Linear elastic with permanent stretch due to creep specified as a user input temperature increase

Name: h:\condumex\pls-cad\bluejay

Description: 1113 kcmil 45/7 Strands BLUEJAY ACSR AW CONDUMEX 17012011

Stock Number: []

Cross section area (mm²): 603.225 Unit weight (daN/m): 1.78629

Outside diameter (mm): 31.9786 Ultimate tension (daN): 13171.5

Number of independent wires (1 unless messenger supporting other wires with a spacer): 1

Conductor is a J-Power Systems GAP type conductor strung with core supporting all tension.

Temperature at which strand data below obtained (deg C): 22.7778

Outer Strands

Final modulus of elasticity (see note below)(daN/mm²/100): 46.7221

Thermal expansion coeff. (/100 deg): 0.002304

Polynomial coefficients (all strains in %, stresses in daN/mm², see note)

	a0	a1	a2	a3	a4
Stress-strain	-0.0897E	46.7221	-64.3672	68.5744	-49.3023
Creep	-0.0897E	46.7221	-64.3672	68.5744	-49.3023

Note: Final modulus, stress-strain and creep are actual material values multiplied by ratio of outer strand area to total area.

Core Strands (if different from outer strands)

Final modulus of elasticity (see note below)(daN/mm²/100): 8.97162

Thermal expansion coeff. (/100 deg): 0.001152

Polynomial coefficients (all strains in %, stresses in daN/mm², see note)

	b0	b1	b2	b3	b4
Stress-strain	-0.03384	8.97162	2.02832	-9.5160E	6.84167
Creep	-0.03384	8.97162	2.02832	-9.5160E	6.84167

Note: Final modulus, stress-strain and creep are actual material values multiplied by ratio of core strand area to total area.

Bimetallic Conductor Model...

Aluminum has a larger thermal expansion coefficient than steel. If Aluminum is used as the outer material over a steel core there is a temperature transition point at which the aluminum is no longer under tension.

Select the behavior you want for temperatures above the transition point

- Use behavior from Criteria/Bimetallic Conductor Model
- Aluminum does not take compression at high temperature (Bird Cage)
- Aluminum can go into compression at high temperature

VirtualStress = ActualStress * Ao / At
 Ao = cross section area of outer strands
 At = total cross section area of entire conductor (outer + inner strands)

Maximum virtual compressive stress (MPa): 68947.4

Thermal Rating Properties

Resistance at two different temperatures

Resistance (Ohm/km)	at (deg C)
0.0526923	25
0.0628828	75

Emissivity coefficient: 0.5

Solar absorption coefficient: 0.5

Outer strands heat capacity (Watt-s/m-deg C): 1489.81

Core heat capacity (Watt-s/m-deg C): 123.024

Buttons: Generate Coefficients from points on stress-strain curve Composite cable properties **OK** Cancel

GENERAL CABLE Polinomy 1113 kcmil acsr/as



Datos técnicos 1 113 kcmil BLUEJAY

datos del cable

Cable Model

- Nonlinear cable model (separate polynomials for initial and creep behavior for inner and outer materials)
- Linear elastic with permanent stretch due to creep proportional to creep weather case tension
- Linear elastic with permanent stretch due to creep specified as a user input temperature increase

Nombre: c:\pls_cfe\pls_cadd\examples\cables\acsr_aw\bluejay_acsr_aw.wll

Descripción: 1113 kcmil 45/7 Strands BLUEJAY ACSR AW - GENERAL CABLE

Stock Number:

Área sección transversal (mm ²)	604.39	Peso unitario (daN/m)	1.78629	Number of independent wires (1 unless messenger supporting other wires with a spacer)	1
Diámetro ext. (mm)	31.98	Tensión última (daN)	14356		

Conductor is a J-Power Systems GAP type conductor strung with core supporting all tension.

Temp. a la cual se obtuvo la info. abajo (deg C): 22.7778

Hilos ext.

Final modulus of elasticity (see note below) (daN/mm ² /100)	52.4001	Hilos del núcleo (si diferente de hilos externos)	10.2235
Coef. dilatación térmica (/100 deg)	0.002304	Final modulus of elasticity (see note below) (daN/mm ² /100)	10.2235
Coef. dilatación térmica (/100 deg)	0.002304	Coef. dilatación térmica (/100 deg)	0.001152

Polynomial coefficients (all strains in %, stresses in daN/mm², see Est.-defor.

a0	a1	a2	a3	a4	b0	b1	b2	b3	b4
1.107136	29.4037	8.4307	-16.5468	14.5313	1.023799	9.90165	0.151861	-1.28262	-1.7127
c0	c1	c2	c3	c4	d0	d1	d2	d3	d4
1.107136	29.4037	8.4307	-16.5468	14.5313	1.023799	9.90165	0.151861	-1.28262	-1.7127

Fluencia

Note: Final modulus, stress-strain and creep are actual material values multiplied by ratio of outer strand area to total area.

Note: Final modulus, stress-strain and creep are actual material values multiplied by ratio of core strand area to total area.

Bimetallic Conductor Model..

Aluminum has a larger thermal expansion coefficient than steel. If Aluminum is used as the outer material over a steel core there is a temperature transition point at which the aluminum is no longer under tension.

Select the behavior you want for temperatures above the transition point

- Use behavior from Criteria/Bimetallic Conductor Model
- Aluminum does not take compression at high temperature (Bird Cage)
- Aluminum can go into compression at high temperature

VirtualStress = ActualStress * Ao / At
 Ao = cross section area of outer strands
 At = total cross section area of entire conductor (outer + inner strands)

Maximum virtual compressive stress (MPa): 60947.4

Propiedades régimen térmico

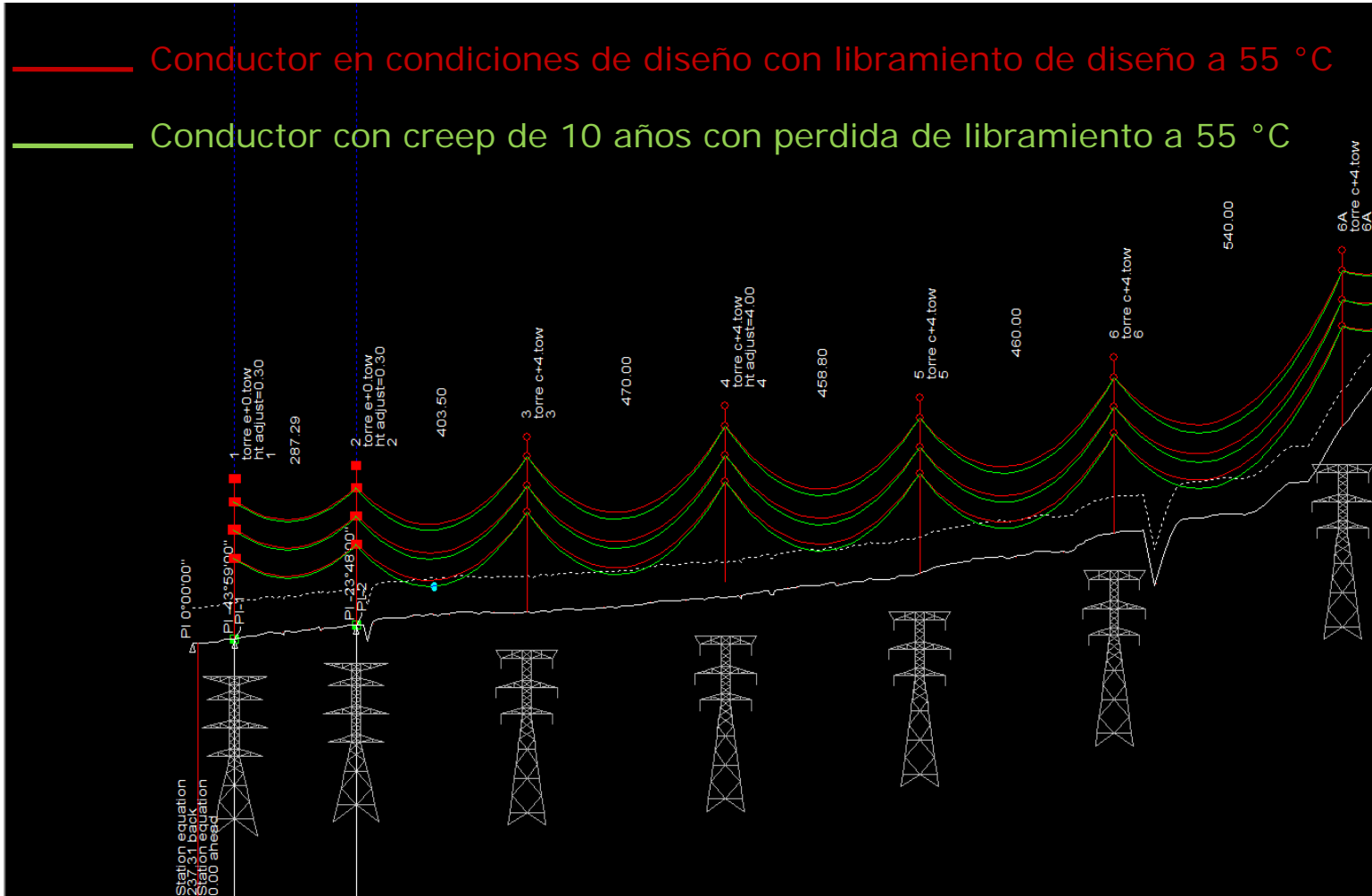
Resistencia a 2 diferentes temp.		
Resistencia (Ohm/km)	0.0526923	a (deg C) 25
Resistencia (Ohm/km)	0.0528828	a (deg C) 75

Coefficiente de emisividad	0.5
Coefficiente de absorción solar	0.5
Capacidad térmica de hilos ext. (Watt-z/m-deg C)	1489.81
Capacidad térmica del núcleo (Watt-z/m-deg C)	123.024

Study case Existent conditions

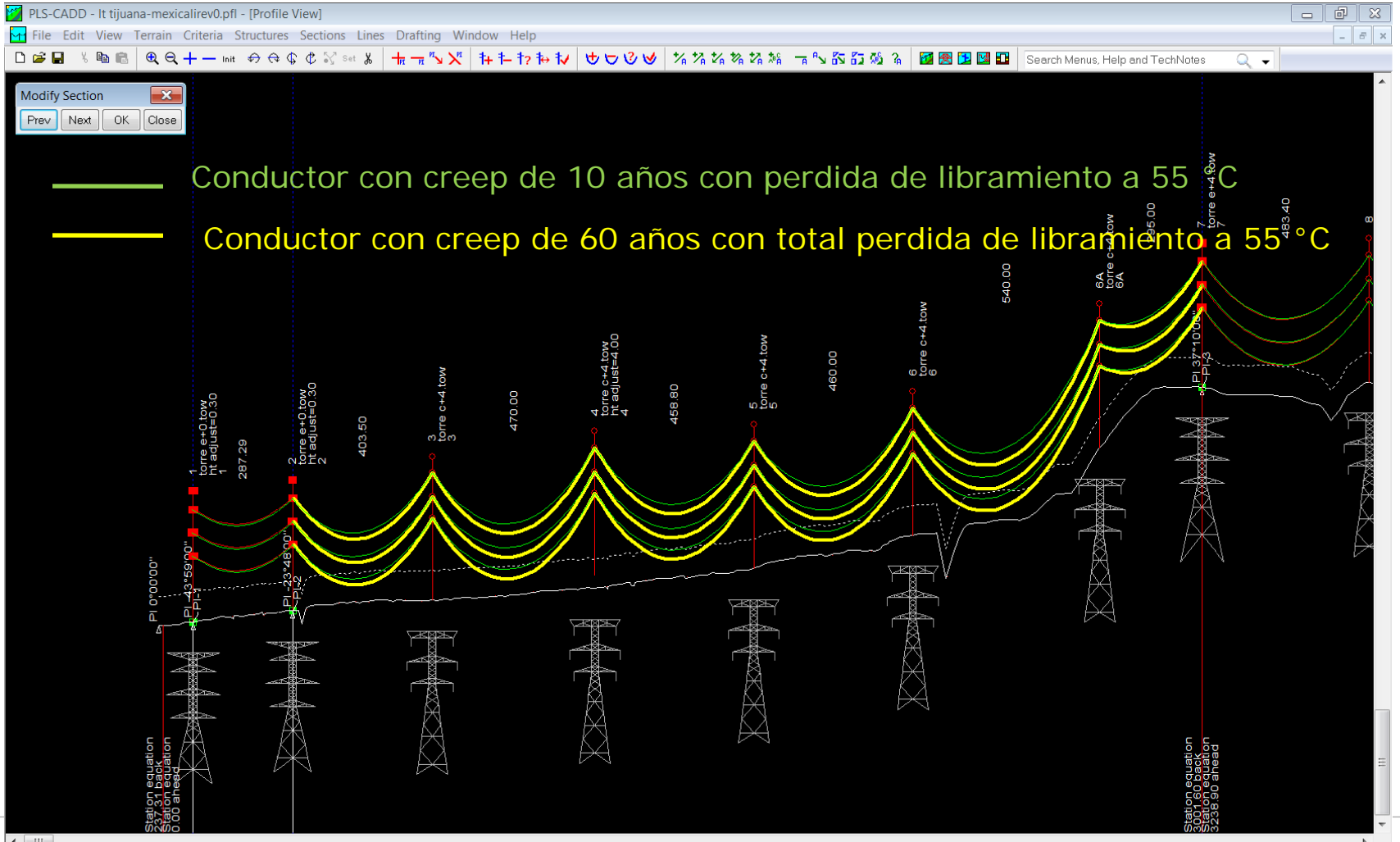
Conductor en condiciones de diseño con libramiento de diseño a 55 °C

Conductor con creep de 10 años con perdida de libramiento a 55 °C



Section Modify (Click on section): Section #4, phase 3, 230kV, 'bluejay_acsr', from Str. #2 Set 6 'Cder-Adel' to Str. #7 Set 5 'Cder-Atras', Section at H2 FLECHA MAXIMA 'Creep RS', S=569.84

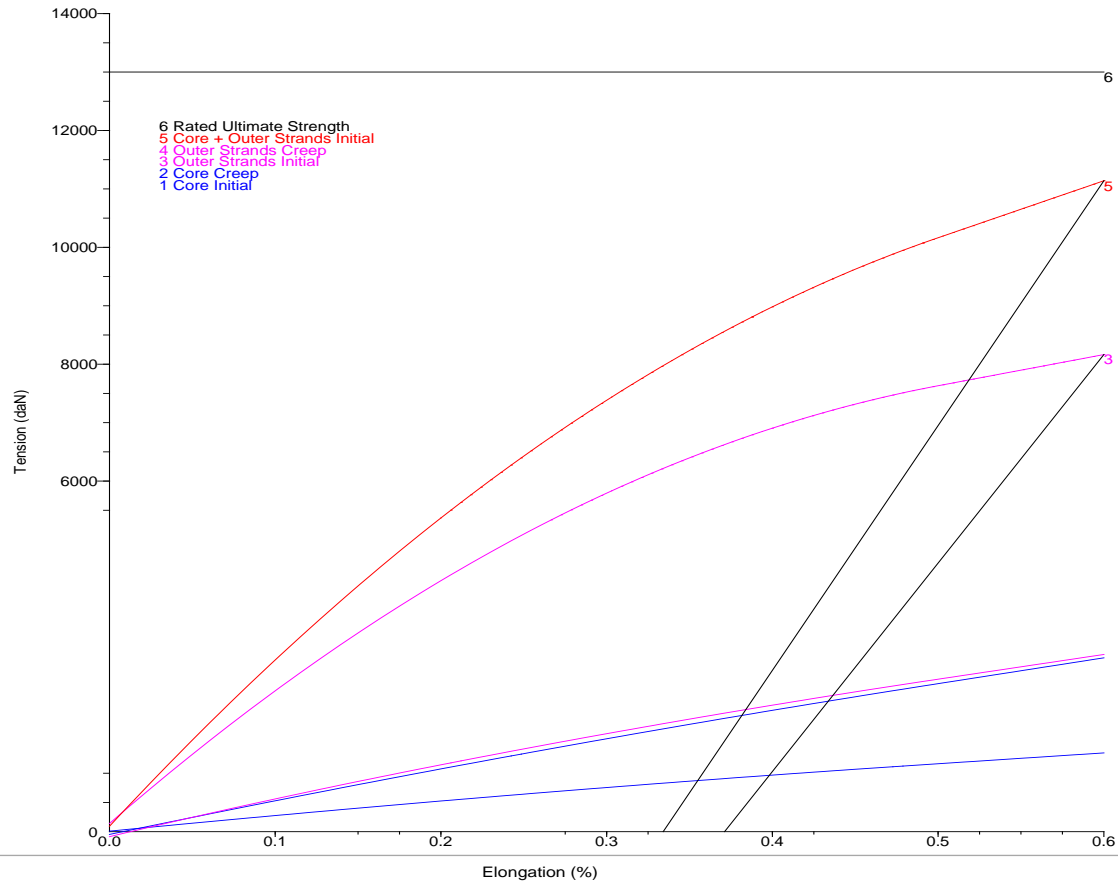
Study case Existent conditions



Section #3, 230kV, 'bluejay_acsr_aw_condumex60', from Str. #2 Set 4 'Cizo-Adel' to Str. #7 Set 3 'Cizo-Atras', Section at H2 FLECHA MAXIMA 'Creep.RS'

60 years creep model

Grafica de Esfuerzo-Deformación y Creep a 60 Años de Cable Conductor 1113 ACSR/AS Blue Jay





Thanks!

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LT LAS MESAS-QUERETARO POT
400 kV-2c-3 cond/f