

SUCOFLEX® 400

Edition 2011



The Loss Revolution





Your partner for system solutions

HUBER+SUHNER is a leading international producer and supplier of electrical and optical interconnectivity components and systems. Core capabilities in radio frequency, fiber optic and low frequency technology are united under a single roof.

The success of the company's high-grade standard products and customised applications based on its cutting edge-know how in radio frequency and microwave technology, supported by advanced simulation processes.

SUCOFLEX 400 – the Insertion Loss Revolution

The SUCOFLEX 400 microwave cable family has been specifically developed for high performance defence, medical, test & measurement technology applications, and anywhere the best insertion loss, high phase stability versus temperature and bending, excellent return loss and mechanical stability are of the utmost importance.

Today's advanced radio frequency systems enable critical applications in defence, medical and test & measurement, and must comply with the highest demands, so it is essential that the interconnection components that they rely on meet the highest standards as well. The SUCOFLEX 400 family, meets these challenges and gives you the opportunity to design with the highest performance microwave cable in its class.



SUCOFLEX 404 – Customer Need

Features

- Best insertion loss on the market up to 26.5 GHz
- High phase stability versus temperature and bending
- Excellent voltage standing wave ratio (VSWR)

Benefits

- Improved system performance in case of reduced phase change over temperature
- Higher signal integrity due to lower loss
- Available as assembly with a tested electrical performance and ready to use
- Excellent performance to price ratio

Applications

Defence

Radar and electronic warfare

Medical

Radio frequency ablation for tumours treatments, connecting RF generators with minimal invasive antenna probes

Test+Measurement

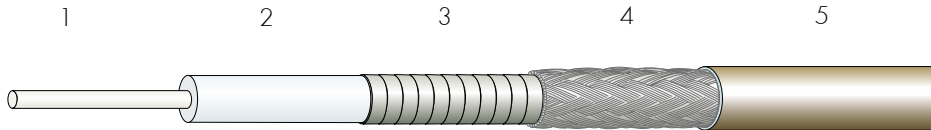
High speed digital testing



SUCOFLEX® is a registered trade mark of HUBER+SUHNER.

SUCOFLEX 404 – Technical Data

Cable Design



Construction

	Material	Diameter
1 Centre conductor	Silver-plated copper wire, solid	
2 Dielectric	Extruded ultra low density PTFE	
3 Inner shield	Silver-plated copper tape	
4 Outer shield	Silver-plated copper braid	
5 Jacket	Fluorinated Ethylene Propylene (FEP)	5.55 mm (0.218 inch)

Electrical characteristics

Impedance	50 ± 1 Ω
Operating frequency	26.5 GHz
Capacitance	74.7 pF/m (22.8 pF/ft)
Velocity of propagation	89 %
Signal delay	3.74 ns/m (1.14 ns/ft)
Nominal phase	1'347°/GHz/m (410.5°/GHz/ft)
Phase stability vs. temperature	see graph 3 and 4 page 9
Phase stability vs. bending, 360°, radius 50 mm	< 1.1° / GHz, max. 18° (0-26.5 GHz)
Insertion loss stability vs. temperature	< 0.0028 /°C
Insertion loss stability vs. bending	< 0.1 dB
Screening effectiveness up to 18 GHz	> 90 dB
Nom. attenuation* coefficients: a: 0.2076 b: 0.0058 Max. attenuation* coefficients: a: 0.2140 b: 0.0064	see graph 1 page 8
Power handling	see graph 2 page 9

Mechanical characteristics

Weight	< 72 g/m
Minimum bending radius static	> 25 mm
Minimum bending radius repeated, 20 cycles	> 35 mm

Environmental characteristics

Operating temperature range	-55° to +125°C
IP rating	IP 68
Halogen free product	no
RoHS (2002/95/EC)	compliant
Concentrated load	> 200 N/100 mm

*Attenuation calculation $\alpha_{25} = a \cdot \sqrt{f} \text{ (GHz)} + b \cdot f \text{ (GHz)} \cdot \text{(length of cable)}$

SUCOFLEX 404 D – Technical Data

Cable Design



Construction

	Material	Diameter
1 Centre conductor	Silver-plated copper wire, solid	
2 Dielectric	Extruded ultra low density PTFE	
3 Inner shield	Silver-plated copper tape	
4 Outer shield	Silver-plated copper braid	
5 Jacket	Fluorinated Ethylene Propylene (FEP)	
6 Ruggedisation	Aramid yarn impregnated	6.1 mm (0.24 inch)

Electrical characteristics

Impedance	$50 \pm 1 \Omega$
Operating frequency	26.5 GHz
Capacitance	74.7 pF/m (22.8 pF/ft)
Velocity of propagation	89 %
Signal delay	3.74 ns/m (1.14 ns/ft)
Nominal phase	$1'347^\circ/\text{GHz/m}$ ($410.5^\circ/\text{GHz/ft}$)
Phase stability vs. temperature	see graph 3+4
Phase stability vs. bending, 360° , radius 50 mm	$< 1.1^\circ / \text{GHz}$, max. 18° (0-26.5 GHz)
Insertion loss stability vs. temperature	$< 0.0028 / ^\circ\text{C}$
Insertion loss stability vs. bending	$< 0.1 \text{ dB}$
Screening effectiveness up to 18 GHz	$> 90 \text{ dB}$
Nom. attenuation* coefficients: a: 0.2076 b: 0.0058 Max. attenuation* coefficients: a: 0.2140 b: 0.0064	see graph 1 page 8
Power handling	see graph 2 page 9

Mechanical characteristics

Weight	$< 82 \text{ g/m}$
Minimum bending radius static	$> 30 \text{ mm}$
Minimum bending radius repeated, 20 cycles	$> 40 \text{ mm}$

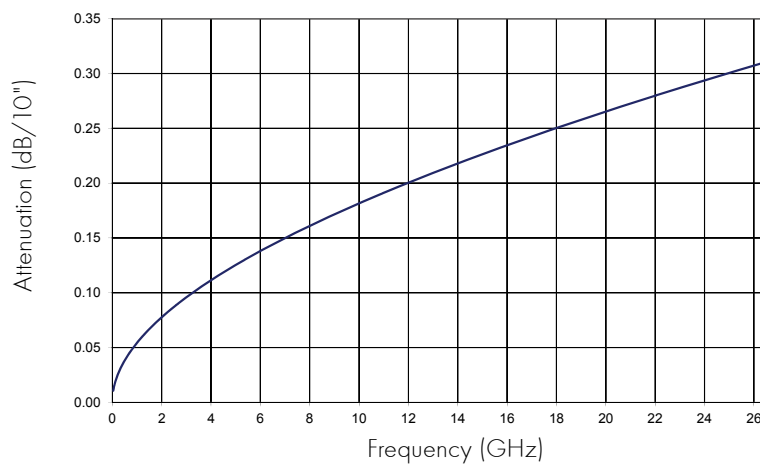
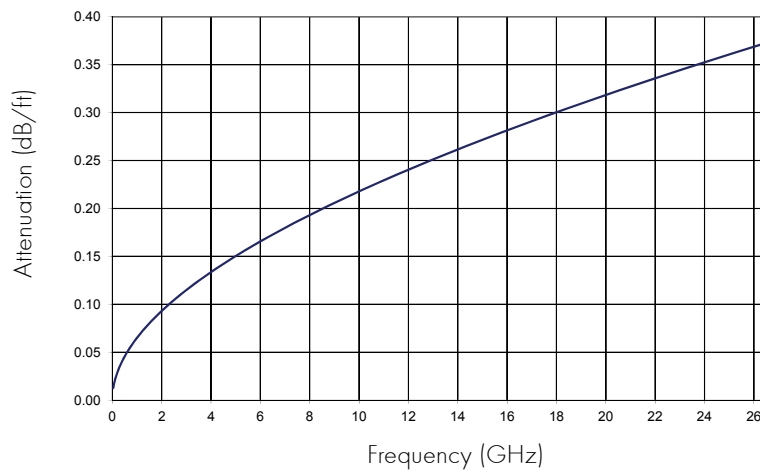
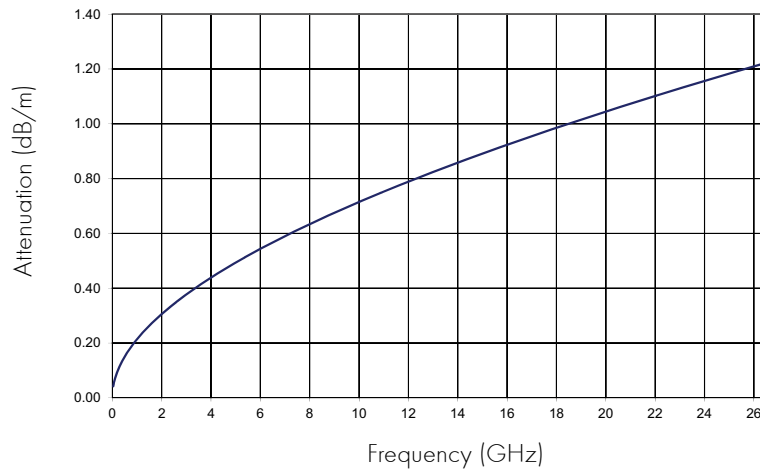
Environmental characteristics

Operating temperature range	$-55^\circ \text{ to } +125^\circ\text{C}$
IP rating	IP 68
Halogen free product	no
RoHS (2002/95/EC)	compliant
Concentrated load	$> 289 \text{ N}/100 \text{ mm}$

*Attenuation calculation $\alpha_{25} = a \cdot \sqrt{f} (\text{GHz}) + b \cdot f (\text{GHz}) \cdot (\text{length of cable})$

SUCOFLEX 404 and 404D- Technical Data

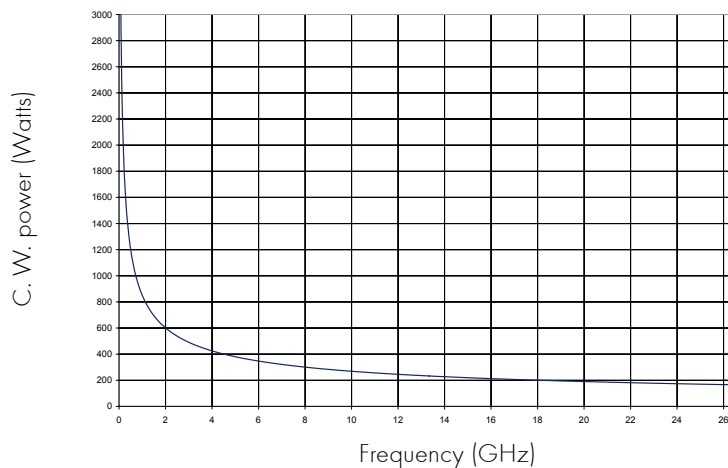
Graph 1: Cable attenuation, nominal values (25 °C ambient temperature)



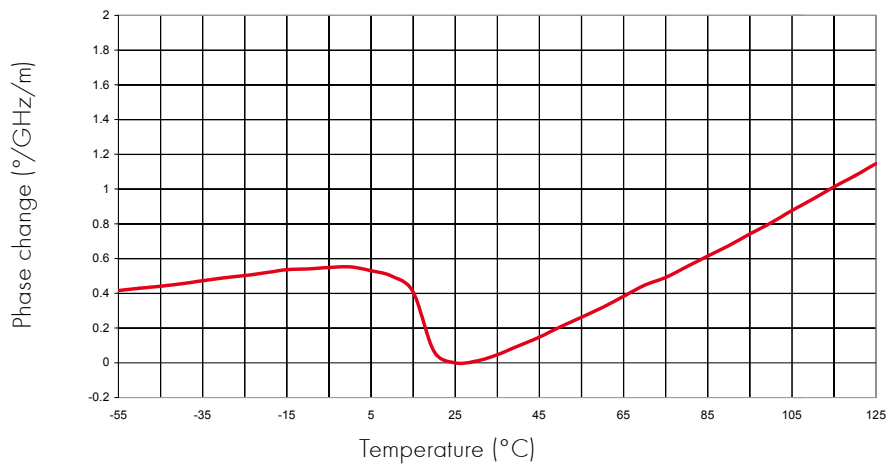
SUCOFLEX 404 and 404D- Technical Data

Graph 2: Max. power handling (40 °C ambient temperature and sea level)

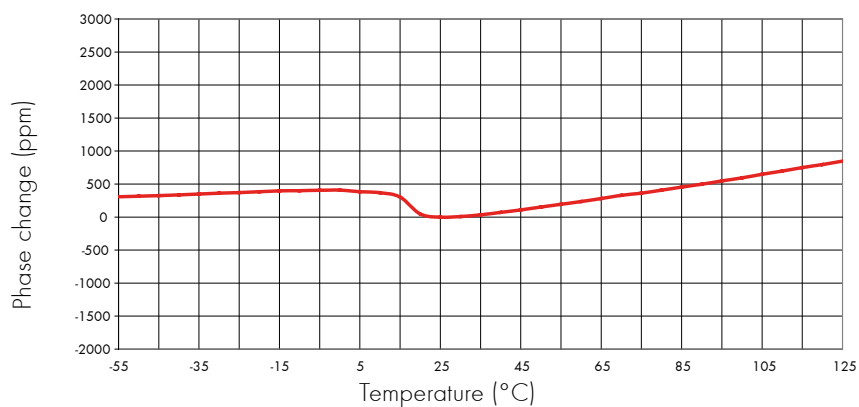
Cables with additional layers, such as our SF 404D may have lower power ratings.



Graph 3: Phase stability vs. temperature in degree (°)



Graph 4: Phase stability vs. temperature in ppm



SUCOFLEX 404

Suitable connectors

Connector	404	404D	Remarks	Operating frequency (GHz)	VSWR ¹⁾ Typical	Guaranteed	Fig.
11_PC35-407	•	•		18 26.5	1.081 1.105	1.106 1.135	1
21_PC35-407	•	•		18 26.5	1.081 1.105	1.106 1.135	2
11_PC35-410	•	•	QM	18 26.5	1.081 1.105	1.106 1.135	3
11_SMA-401	•	•		18	1.120	1.153	4
11_N-431	•	•	MIL	18	1.105	1.120	5
11_TNCA-401	•	•	MIL	18	1.140	1.160	6

Connector patterns

11 Straight cable plug	¹⁾	VSWR per connector
21 Straight cable jack	MIL	Connector with safety holes and hex nut for military and airframe applications
	QM	Quick Mate nut, not for permanent applications

Note: For dimensioned sketches of connectors, please refer below/following

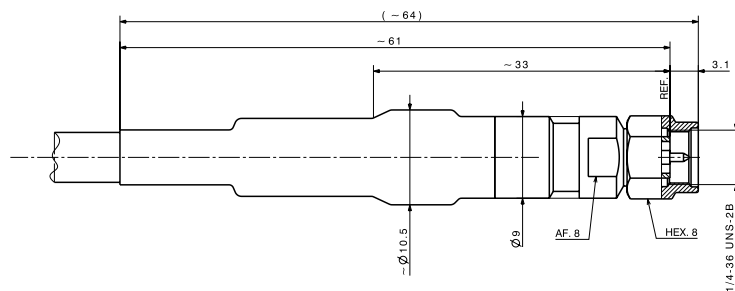


Fig. 1 (11_PC35-407)

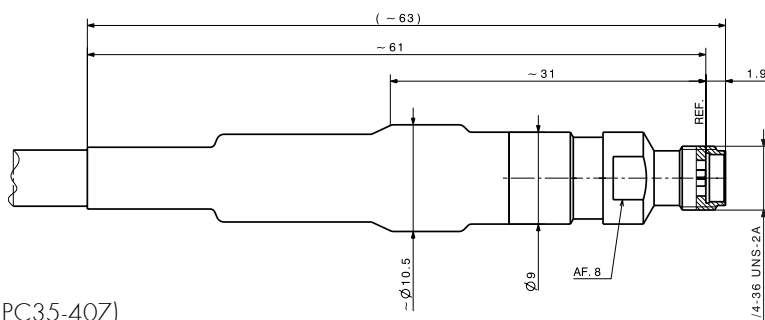


Fig. 2 (21_PC35-407)

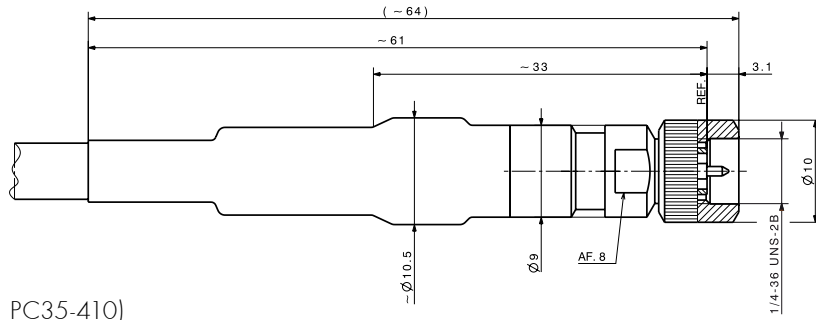


Fig. 3 (11_PC35-410)

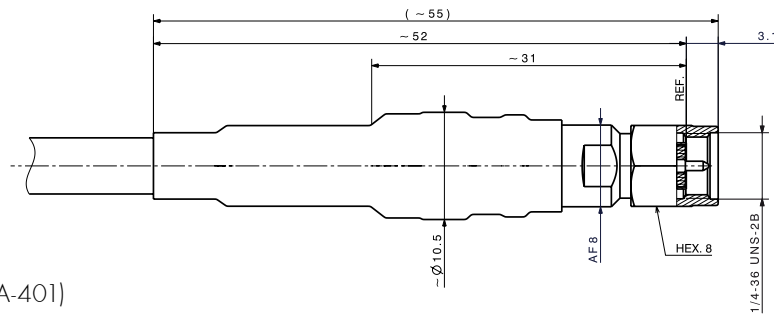


Fig. 4 (11_SMA-401)

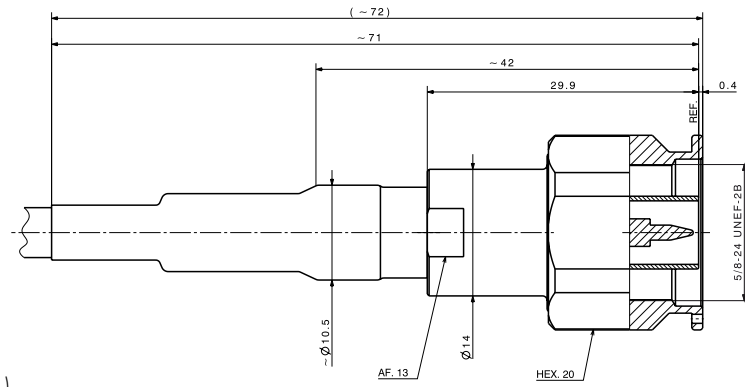


Fig. 5 (11_N-431)

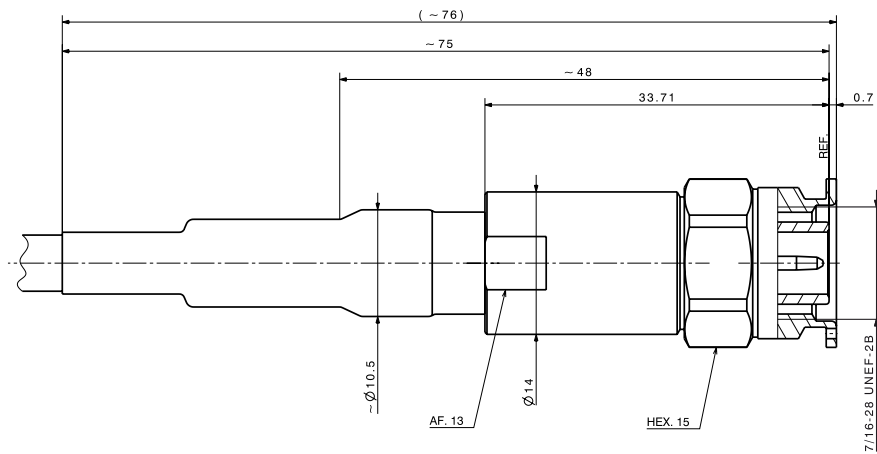


Fig. 6 (11_TNCA-401)

SUCOFLEX®

Electrical length and phase matching

General

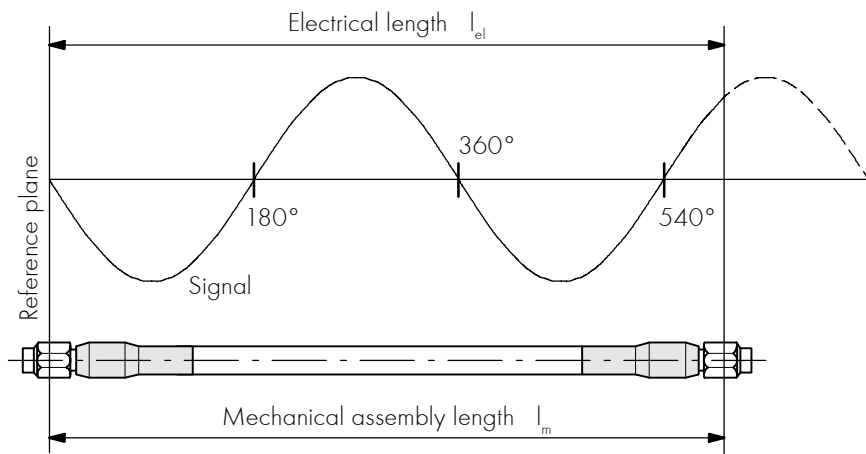
Basically, a distinction must be made between the following terms

Electrical length	Phase change
Phase matching	Time delay

Electrical length

Definition

The term «electrical length» refers to the length of an assembly stated in wavelength or preferably in electrical degrees. In this connection, the term «absolute phase» is sometimes also used.



Determination

The electrical length l_{el} is calculated in the following way

$$\phi_{25} = 1.2 \cdot f \cdot l_m \cdot \sqrt{\epsilon_r}$$

where f must be entered in GHz and l_m in mm. The nominal value of ϵ_r is 1.26.

Example

Assembly SUCOFLEX_404, 1000 mm length, operating frequency range 10 GHz. Thus, the electrical length amounts to

$$\phi_{25} = 1.2 \cdot f \cdot l_m \cdot \sqrt{\epsilon_r} = 1.2 \cdot 10 \cdot 1000 \cdot \sqrt{1.26} = 13470 \text{ deg}$$

This calculation does not take the connectors into account; merely an approximation is supplied.

RF Cable calculator

HUBER-SUHNER | EXCELLENCE IN CONNECTIVITY SOLUTIONS

■ CALCULATOR FOR COAXIAL CABLE

Cable parameters
 Choose cable: **SUCOFLEX_404** (Please "to print" to extract input data)

■ INPUT	■ OUTPUT	■ CONTACT
Wave length (cm)	Wave length (m)	HUBER-SUHNER 404
Frequency (GHz)	Signal delay (ns)	Capacitance parameter T4
Cable length (m)	Velocity of propagation (%)	9500 Series: 4R
Coefficient A internal	Velocity of propagation (cm/s)	■ DOWNLOADS
Coefficient A external	Formal phase (deg)	Formulas (PDF)
Coefficient B internal	Attenuation internal (dB)	
Coefficient B external	Attenuation external (dB)	
Ambient Temperature T (°C)		
Temp. Coeff. J (1/°C)		

■ CALCULATE

■ INPUT

Attenuation [dB]

Power [dBm]

• Attenuation internal
 • Attenuation external

Impedance, Cut-off, Capacity

■ INPUT	■ OUTPUT	■ SKETCH
Outer diameter (mm)	Characteristic impedance (Ohm)	
Inner diameter (mm)	Cut-off frequency (GHz)	
Dielectric constant (εr) (required)	Capacity (pF/m)	
different dielectric constant (εr) can be entered as list		

Power, VSWR

■ INPUT	■ OUTPUT
Power forward (W)	Power reflected (W)
Return loss (dB)	VSWR or Voltage standing wave ratio
	Return loss (dB)
	Reflection loss (dB)
	Reflection factor

■ CALCULATE

arkon soft | © Huber 2014 | 14.0207 | 4.00.023.40 | programmed by: mlabende.sp

Can you calculate a microwave coaxial cable?

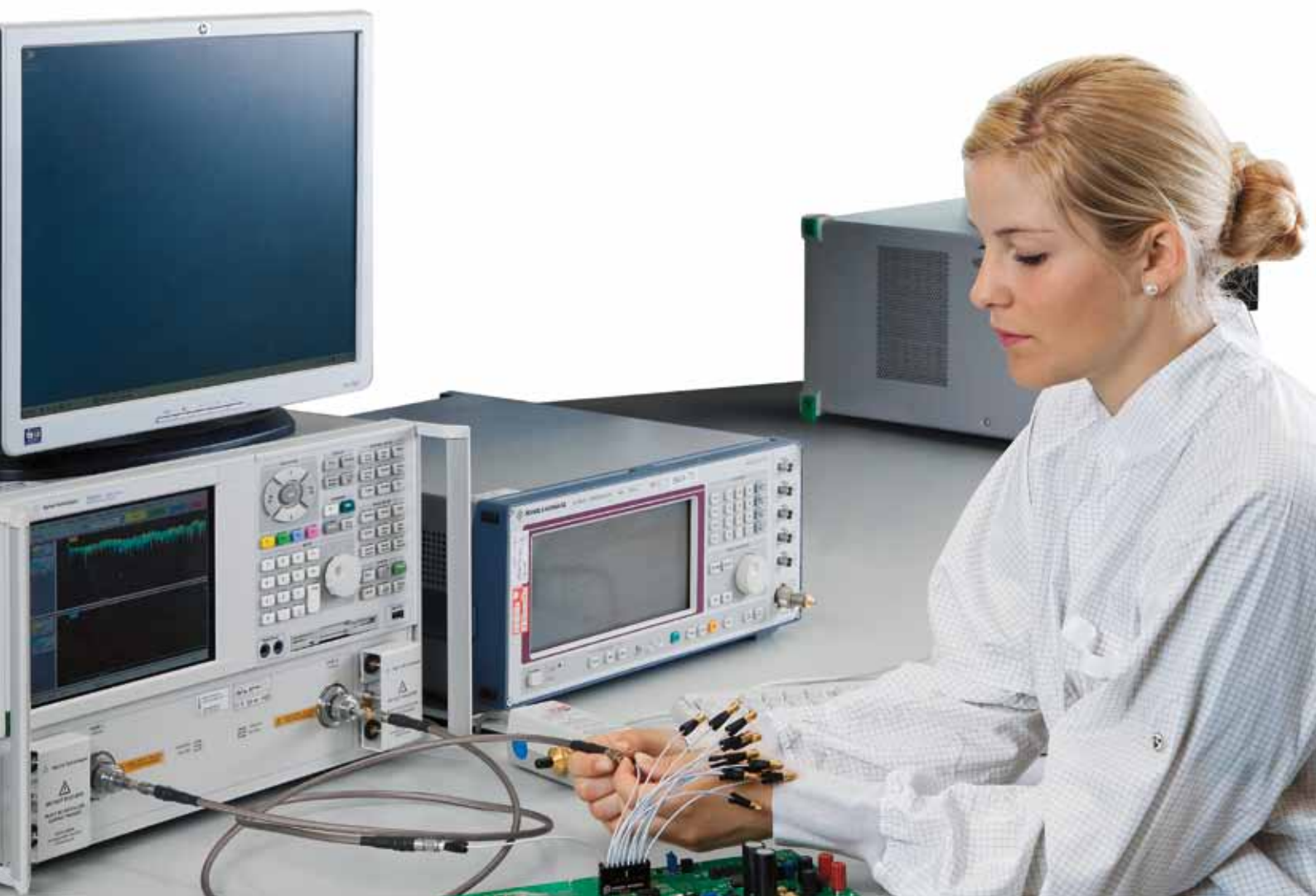
The easy way to get technical parameters, such as Wave length, Velocity, Attenuation, VSWR, Reflection loss. For Sucoflex and any other coaxial cables.

<http://rfcablecalc.hubersuhner.com>

Performed Qualification Tests for SUCOFLEX 404 and 404D

Verification tests	Standards	Results
Design and construction	MIL-T-81490A, Paragraph 4.7.1	Compliant
Marking	MIL-T-81490A, Paragraph 4.7.1	Compliant
Workmanship	MIL-T-81490A, Paragraph 4.7.1	Compliant
Insertion loss	based on IEC 61196-1-113	«Compliant According HS specification»
Return loss (VSWR) - cable assemblies	based on IEC 61196-1-112	«Compliant According HS specification»
Rf leakage	based on IEC 61726	«Compliant According HS specification»
Characteristic impedance	based on MIL-DTL-17H, Paragraph 4.8.7	Compliant
Velocity of propagation	based on IEC 61196-1-108	«Compliant According HS specification»
Withstand voltage	MIL-STD-202G, Method 301	«SUCOFLEX 404 2'000 (rate 500 Vrms/s) SUCOFLEX 404D 2'000 (rate 500 Vrms/s)»
High potential withstand voltage	«MIL-T-81490A, Paragraph 4.7.24, Procedure I and MIL-STD-202G, Method 301»	«SUCOFLEX 404D with N connectors 2'000 V»
Concentrated load	based on MIL-T-81490A, Paragraph 4.7.18	«SUCOFLEX 404 45lbf (200 N) / 100 mm SUCOFLEX 404D 60lbf (289 N) / 100 mm»
Minimum bending radius	based on IEC 61196-1 (revision 1995), Paragraph 10.2	«SUCOFLEX 404 25 mm SUCOFLEX 404D 30 mm»
Flex life	based on MIL-T-81490A, Paragraph 4.7.15	«SUCOFLEX 404 250 cycles / radius 50 SUCOFLEX 404D 500 cycles / radius 50»
Tensile load	based on MIL-T-81490A, Paragraph 4.7.17	115N
Abrasion - chafing	based on MIL-T-81490A, Paragraph 4.7.19	«Compliant SUCOFLEX 404 1.0 lb (0.45 kg) 500 SUCOFLEX 404D 1.0 lb (0.45 kg) 500»
Mechanical shock	MIL-STD-810G, Method 516.6	Compliant
Vibration - high frequency	MIL-STD-202G, Method 204D, Condition G	Compliant
Vibration - gunfire	«MIL-STD-810G, Method 519.6 - ANNEX D, Figure 519.6 D-1»	Compliant
Vibration - random	MIL-STD-810, Method 514.6 ANNEX D	Compliant
Acceleration	«MIL-STD-810G, Method 513.6, Procedure I and II»	Compliant
Temperature-humidity-altitude	«based on MIL-STD 810G, Method 520.3, Procedure III (Figure 520.3-1)»	Compliant
Cold bend	MIL-DTL-17H, Paragraph 4.8.19	-65°C
Icing/freezing rain	MIL-STD-810G, Method 521.3	Compliant
Moisture resistance	MIL-STD-202G, Method 106G	Compliant
Fungus resistance	MIL-STD-810G, Method 508.6	Compliant
Salt fog	«MIL-STD-810G, Method 509.2 (48 hours, exposure to a 5% solution)»	Compliant

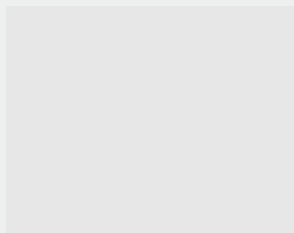
Contamination by fluids	MIL-T-81490A Jet Fuel JP-8, Skydrol LD-4 Mobile Jet Oil II, Ethylene Glycol, Octagon Octaflo, Cryotech E-36	Compliant
Explosive atmosphere	MIL-STD-810G, Method 511.5, Procedure I.	Compliant
Sand and dust	«Def. Stand. 07-55, Part 2, section 4, issue 1 (+35°C, 3 hours)»	Compliant
Smoke index	«Naval engineering Standard 711 (140°F for 24 hours, conditioned at 73°F and 50% relative humidity)»	Compliant
Solar radiation	MIL-STD-810, Method 505, Procedure II	Compliant
Flammability	MIL-C-87104, Paragraph 4.6.4.8	Compliant



HUBER+SUHNER is certified according to
ISO 9001, ISO 14001, ISO/TS 16949 and IRIS.

WAIVER

It is exclusively in written agreements that we provide our customers with warrants and representations as to the technical specifications and/or the fitness for any particular purpose. The facts and figures contained herein are carefully compiled to the best of our knowledge, but they are intended for general informational purposes only.



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Mixed Sources

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