

# HYPERCELL® 2002



*Cables and accessories for radiocommunication networks*



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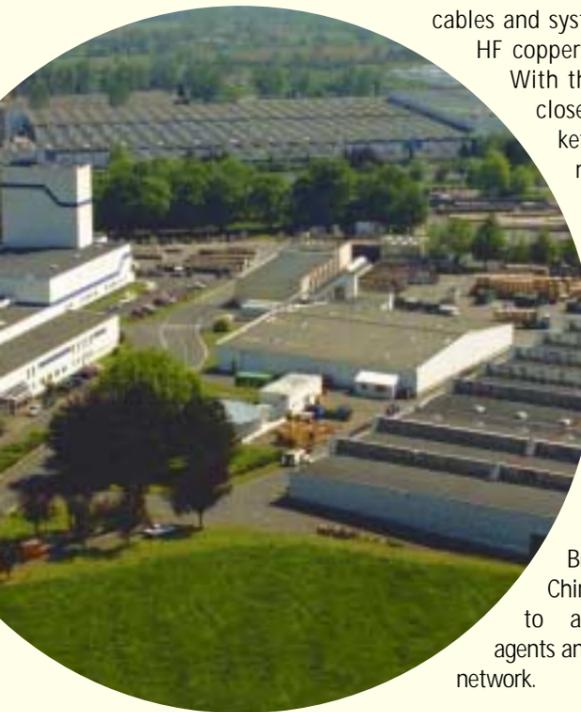
# HYPERCELL®

## ACOME presentation

For more than 60 years, ACOME's experience has been based on its ability to constantly offer technological innovations to the market. Today, ACOME has acquired a unique expertise in the design, production and marketing of cables and systems in use in Telecommunication, automotive and building industry.

With more than 1200 employees and 110.000m<sup>2</sup> of production facilities on its main site located in Mortain (Normandy), ACOME is recognized as a world leader in the design, manufacturing and marketing of low loss HF coaxial cables and accessories, optical fiber cables and systems, LF and HF copper pair cables.

With the aim to be close to its markets and customers, ACOME is present in all of the international markets, and particularly in emerging markets with production facilities in Brazil and China, in addition to a worldwide agents and distribution network.



### ACOME and the Telecom industry

- 1932 Set up of ACOME (Association Coopérative d'Ouvriers en Matériel Électrique).
- 1949 ACOME is the first manufacturer to insulate Telecom wires with polyvinyl chloride (PVC).
- 1954 First vinyl compound production plant for cable insulation and jacketing.
- 1960 Over 30% of french cars are equipped with ACOME sparking plug leads.
- 1972 ACOME manufactures in France a new range of corrugated outer conductor coaxial cables.
- 1976 ACOME is the first french manufacturer to introduce e-beam technology for polymer cross-linking.
- 1977 Development of double layers cellular extrusion.
- 1983 First production of optical fiber cables.
- 1984 Mass production of cross-linked insulated wires.
- 1993 ISO 9001 certification.
- 1998 QS 9000 certification.
- 1999 Installation of the first tower of the cable fibre-drawing plant.
- 2000 The industrial site of Mortain is ISO 14001 certified.



# HYPERCELL®

## ACOME presentation

### DATA TELECOM Division

Copper and optical fiber cables for:



- LAN, MAN & WAN networks
- Industrial and automated control networks
- Telecom trunk, distribution and subscribers networks
- Switching and transmission equipments.

### ELECTRICAL EQUIPEMENT Division

Wires and cables for:

- Automotive industry
- Transport networks
- Railways and naval construction equipments.



### BUILDING components Division

Profiled and tube sections for:



- Heating and cooling floor systems
- Fluid distribution systems
- Profiled sections for windows.

### RADIO VIDEOCOM Division

Twenty years at the service of mobile communication, telecommunication and broadband videocommunication networks operators have led ACOME to constantly improve the quality and reliability of its products and services in order to meet the ever-evolving needs of these markets world-wide.

The Radio Videocom division offers a full range of low loss 50 Ohm coaxial cables designated as HYPERCELL®, and characterised by a cellular foam polyethylene (PE) dielectric, overlaid with a corrugated copper tape (Flexible & SuperFlexible of serie F & SF), or with a copper or aluminium tape and braid for ExtraFlexible cables of serie XF.

The design and choice of connectors and accessories necessary to a complete feeder line system, optimised for each cable size, ensure a perfect electrical and mechanical integrity of the coaxial transmission line between radio equipments and between transmitters or base stations and antennas.

The HYPERCELL® cable range meets the demand of the different markets utilising low loss foam dielectric coaxial cables. These markets are:

Mobile communication networks.  
Private and Government telecommunication networks. (PMR, Microwave, Wireless Local Loop)  
Radio and television broadcast.

With the following main customers:

- Private and public networks operators.
- Installers.
- Radio equipment manufacturers (OEM).
- System integrators.
- Industry, Transport, Security and Defence.
- Radio and TV broadcasters.

In addition, the Radio Videocom division offers the GIGACOME®, range of 75 Ohm coaxial cables for CATV videocommunication networks.

Each of the four Operating divisions is structured and organized to answer the specificity of its targeted markets and customers.



# HYPERCELL®

## ACOME presentation

### ACOME: an optimised service

Fully aware of its role as an advisor, a solution specifier and a provider of technical and sales support, ACOME offers a customised service that guarantees the commitment of all the employees to deal with and satisfy the customer's demand with efficiency, flexibility and punctuality.



Without being exhaustive, these services particularly apply to:

- Technical assistance to system design.
- Product training and site installation.
- Pre-commissioning and assistance to commissioning.
- Special packing and specific conditioning.
- EDI links with our customers and partners.

From its 25000 m<sup>2</sup> logistical platform, the ACOMEX department delivers from stock in less than 72 hours throughout the whole Europe; an express required delivery in France will be guaranteed within 24 hours and requests for urgent delivery will be processed immediately with the sole limitation of the transport time.



### ACOME: a leader in many technologies

With a budget in excess of 10% of sales, the R & D department maintains a permanent technological survey on material, products and processes in order to achieve a triple objective:

- Constantly improve the existing products.
- Develop new products for existing and emerging markets.
- Provide technical and scientific support to our customers.

ACOME is actively involved in the international standardisation committees which guarantee the involvement in the latest technological innovations and standards.

ACOME is specialised in a number of technical processes such as metal-working/wire-drawing, plastics chemistry, plastics extrusion, electro-physical cross-linking and drawing of silicium preforms.

ACOME delivers to its customers the most advanced products while keeping them constantly informed of the new technologies that have been used during the production of these products.



# HYPERCELL®

## ACOME presentation

### ACOME: quality, a constant concern

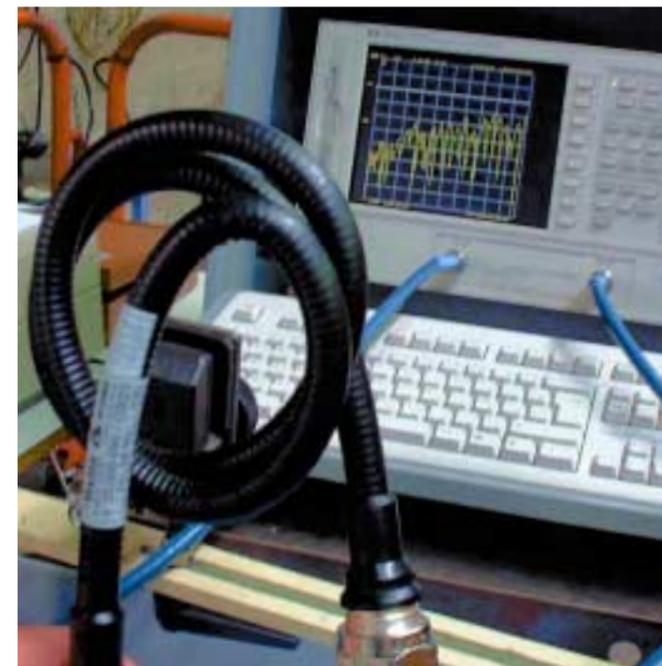
The objective of quality is effective at all stages, from design, to production and marketing.

It is achieved through high personnel involvement at every level of responsibility, as soon as the original customer contact and the commercial proposal until the product shipment and the after-sales services.

The demand for quality is also enlarged to develop procedures for the environment protection in all manufacturing processes and production stages.

This level of Quality Assurance has allowed ACOME to receive the following world-wide recognition:

- ISO 9001
- QS 9000 (Automotive Ind.)
- ISO 14001 (Industrial site of Mortain)



All the products announced in this catalogue, fitted and installed in accordance with assembly instructions and state of the art good practices are guaranteed for a period of 10 years.

# HYPERCELL®

## The HYPERCELL® coaxial cable range

The 50 Ohm low loss foam dielectric coaxial cables are available in three different versions:

**Flexible (F serie)** featuring an annularly corrugated outer conductor available in diameters of 1/4", 3/8", 1/2", 5/8", 7/8", 1-1/4", 1-5/8" & 2-1/4".

**SuperFlexible (SF serie)** manufactured with helical corrugation in the outer conductor in diameters of 1/4", 3/8" & 1/2".

**ExtraFlexibles (XF serie)** overlapping tape and braid as outer conductor in diameters of 1/16", 1/4" & 3/8".

All of these cable are constructed with an inner conductor, a low loss foam dielectric, an outer conductor and a protective jacket.

The inner conductor is made of a copper wire, a copper clad aluminium wire, a smooth or corrugated copper tube, according to the different cable size. The high conductivity copper which is used allows to perform very low attenuation.

The dielectric insulator is extruded and bonded to the inner conductor, thus preventing any longitudinal movement due to temperature changes or mechanical constraints. This foam insulator is made of a mixture of low loss dielectric polyethylene melted and extruded with an inert gas injection process. This method allows to produce low density, fine close and homogeneous cells. A very thin layer of polyethylene is finally applied which profiles the diameter consistency of the cable core, thus guaranteeing a very high mechanical integrity and accurate concentricity over the inner conductor for a remarkable impedance regularity.

This dielectric being non hygroscopic, it ensures a much extended service of the cable in adverse environment. The outer conductors of Flexible (F serie) and SuperFlexible (SF serie) coaxial cables are made with a oxygen free copper tape having an electrical conductivity of more than 100% IACS, which is formed, seam welded and helicaly or annularly corrugated around the core.

The outer conductor of the ExtraFlexible cable range (XF serie) is made of an overlapped aluminium tape covered with a tinned copper braid (diameter 1/16" & 1/4") or a copper tape and braid for 3/8" diameter.

The halogen free, carbon black polyethylene jacket is extruded around the outer conductor. It provides a high resistance to abrasion, and protects the cable against very adverse weather conditions and ultra-violet rays. They comply with IEC60754-1 and 60754-2 standards.

ExtraFlexible cables (XF serie) being normally installed inside equipments or equipment room are provided with a PVC protective jacket which meet the requirement of IEC 60332-1 standard.

For many applications inside buildings, confined spaces tunnels and metros, the whole range of HYPERCELL® cables can be offered with an halogen free, fire retardant, low smoke and gas emission jacket.

These jackets referenced LSOH have successfully passed the tests specified by the following international standards:

- IEC 60754-1 Gases emitted during combustion (Hydrochloric acid < 0.5%)
- IEC 60754-2 Acidity index of gases (pH > 4.3, conductivité < 2.5µ Siemens/mm).
- IEC 61034 Smoke generation of solid material.
- IEC 60332-1 Tests on a single vertical cable under fire conditions (flame retardant cables)
- IEC 60332-3A Tests on bunched vertical cables under fire conditions. (fire retardant cables)

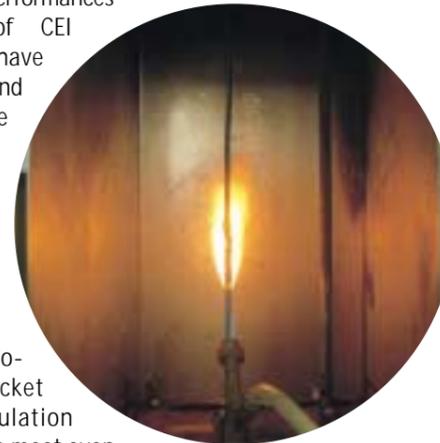


# HYPERCELL®

## The HYPERCELL® coaxial cable range

HYPERCELL® cables are also available with HFR jacket, which, in addition of the LSOH fire retardancy performances requirement of CEI 60332-3 A, have been tested and approved by the Underwriters' Laboratories Inc. (UL 1666/ CATVR - file E195007 & E205044).

Other non-halogenated jacket material formulation are available to meet even more stringent requirements of specific standards such as RATP K26 (Parisian Metro).



HYPERCELL® cable range provide high flexibility while keeping outstanding mechanical and electrical characteristic, tested under the stringent procedures of following international standards:

- Bending radius and flexibility CEI 60 966 - 9.3-9.5-9.6
- Tensile & Crush strength. CEI 60 966 - 9.1-9.4
- Uniformity of impedance CEI 60 966 - 8.2
- Environmental CEI 60 966 - 10.3-10.4-10.5
- Waterproofing CEI 60 966 - 10.7
- Impedance NFC 90131/CEI 60 966 (9.2)
- Attenuation & relative velocity CEI 60 966 - 8.3-8.5
- Power rating CEI 96-0-1
- VSWR CEI 60 966 - 8.1
- Screening effectiveness (EMI/RFI) CEI 60 966 - 8.9

### Definitions

**Minimum bend radius:** The smallest radius a cable can be bent without compromising electrical performances or damaging the cable (Typically 10 times the diameter of the cable).

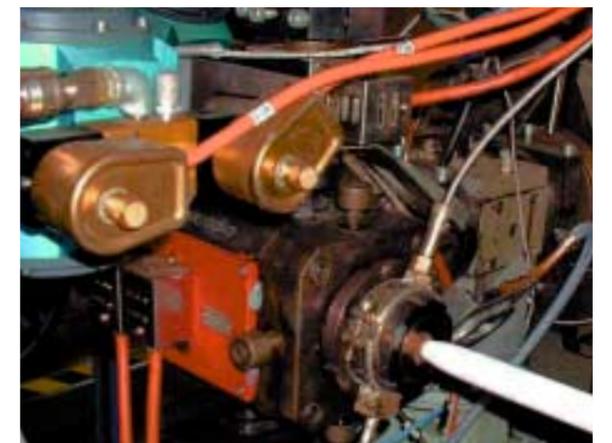
**Tensile strength:** The force required to cause a 0.1% permanent elongation of the cable.

**Crush Strength:** The force required to cause a 1% deformation of the cable diameter.

**Average Power:** It represents the safe long term operating temperature of the dielectric, based on VSWR of 1.00, Ambient temperature of 40°C and inner conductor temperature of 100°C.

**Attenuation:** This is the measurement in dB of signal loss in a cable as a result of:

- Inner and outer conductor losses
- Dielectric loss
- Radiation loss, based on 20°C ambient temperature and VSWR of 1.00.



**Shielding (EMI/RFI):** Ability of the cable to keep unwanted signals out and wanted signals in. Shielding effectiveness ensures transmission security, eliminates interferences and reduces attenuation while allowing use of higher power.

Performance of corrugated cables exceed -120dB.

# HYPERCELL®

## The HYPERCELL® coaxial cable range

### Return Loss (R.L.)

This is the decibel (dB) power ratio of the incident power to the reflected power @ 20° ambient temperature. It can be converted in VSWR or Reflection coefficient.

The ACOME cables of the HYPERCELL® range being manufactured and controlled according to very severe standards, show return loss values (R.L.) which solely depends on the frequency range of the cable, without any selection.



Frequency MHz	R.L.dB (ROS) typical	R.L.dB (VSWR) max
1-400	-23 (1.15)	
400-500		-26.5 (1.10)
500-800	-23 (1.15)	
800-1000		-26.5 (1.10)
1000-1700	-23 (1.15)	
1700-2200		-24.0 (1.12)
2200-2500	-23 (1.15)	
2500-2700		-23.5 (1.13)
2700-3000	-23 (1.15)	

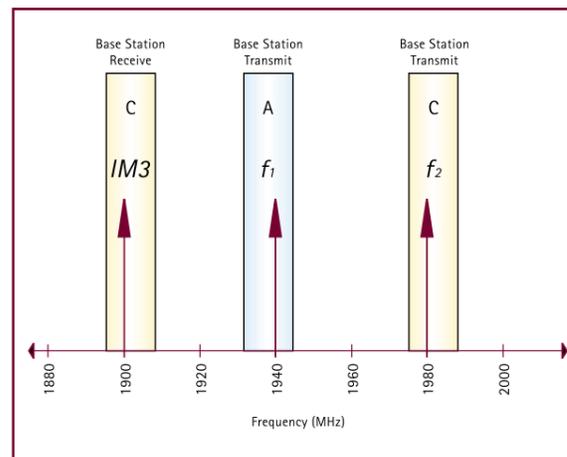
### Passive intermodulation

Passive intermodulation (PIM) is a form of signal distortion that occurs whenever two or more frequencies signals conduct simultaneously in a passive device, such as a cable or connector, which contains some nonlinear response. The non-linear behavior produces spurious signals whose frequencies are linear combinations of the frequencies of the original signals.

The lower odd-ordered intermodulation (IM) products (e.g.  $f_{IM3}=2f_1-f_2$ ) are usually the most problematic in the wireless industry since they have the highest potential of falling within the receive band, or up-link, of a base station, creating radiofrequency interference in the receiver. Although frequency allocations are specifically designed to guard against this problem, collocation of two or more base station transceivers at a single site substantially increases the risk of PIM interference, as illustrated in figure below.

Base stations built for mobile communications systems such as Personal Communication Service (PCS 1900), Advance Mobile Phone System (AMPS), Global System for Mobile communications (GSM), and Digital Communications System (DCS 1800), use DIN 7-16 and Type N coaxial connectors to handle the high transmit power requirements.

At high power (above 1W), non-linearities in coaxial connectors become apparent and measurable. The many possible causes of intermodulation in coaxial connectors and cables include poor mechanical contact, dissimilar metals in direct contact, ferrous content in the conductors, debris within the connector, poor surface finish, corrosion, vibration, and temperature variations.

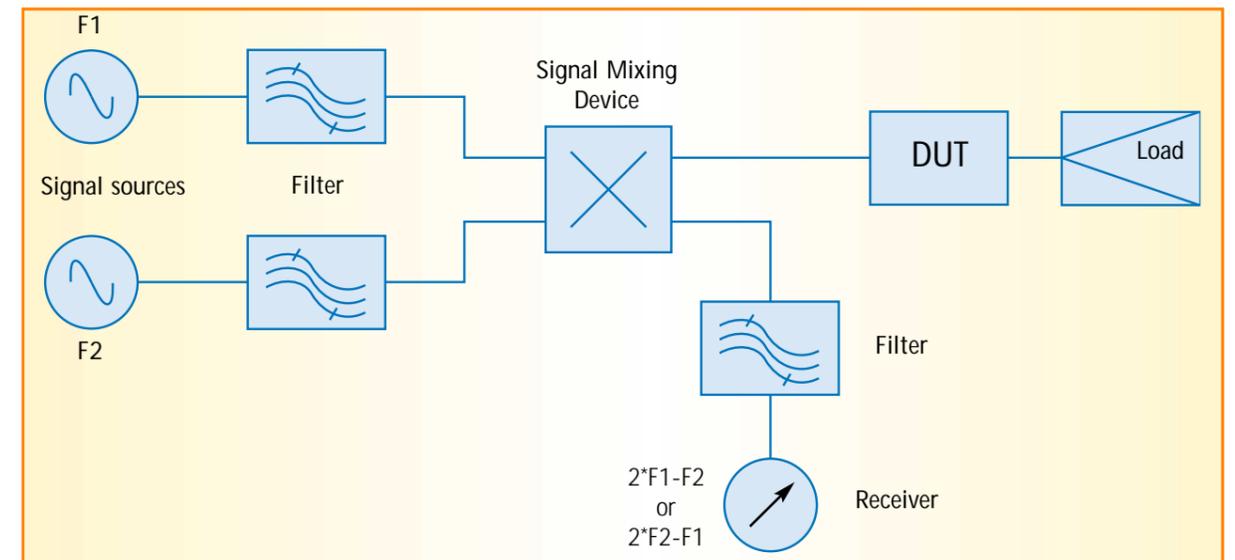


# HYPERCELL®

## The HYPERCELL® coaxial cable range

The figure above shows the potential third order intermodulation distortion occurring in two collocated base station transceivers in the broadband PCS band. Bands A and C are both transmitting, and a non linearity cause a third order IM distortion to appear in the receive area of band C. [  $f_{IM3} = 2f_1 - f_2 = 2 \cdot 1940 - 1980 = 1900 \text{ MHz}$  ]

### Measurement techniques: the reflected sweeping method



Measurements can be obtained in two ways:

- Holding the source 1 at the frequency F1 and sweeping source 2 from F2 min to F2 max in defined steps (with F1 less than equal F2 min).
- Holding source 2 at the frequency F2 and sweeping source 1 from F1 min to F1 max in defined steps (with F2 greater than equal F1 max).

For example, in the GSM band, measurements can be done in holding source 2 at  $F_2 = 960 \text{ MHz}$  and sweeping source 1 upward from  $F_{1min} = 925 \text{ MHz}$  to  $F_{1max} = 935 \text{ MHz}$  in steps of 2.5 MHz.

This method allows a curve representation of the passive intermodulation versus the swept frequencies or the intermodulation product ( $2 \cdot F_1 - F_2$ ). Usually, PIM results are expressed in dBc, that means measurements results in dBm are compared to the source power.

For example, source carrier power is set to  $P_c = 40 \text{ dBm}$ , and PIM measurement gives value of  $R = -110 \text{ dBm}$ , result expressed in dBc is obtained by doing the following calculation:

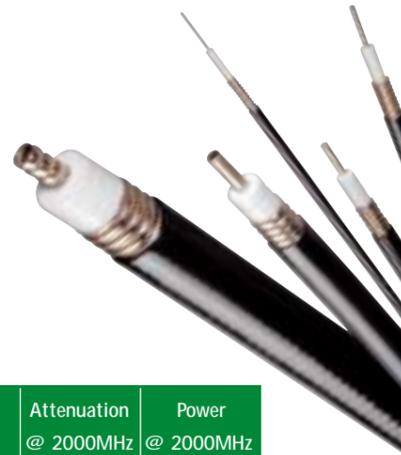
$$\text{PIM (dBc)} = P_c (\text{dBm}) - R (\text{dBm})^*$$

\*In the example,  $\text{PIM} = -150 \text{ dBc}$ .

It must be noted that the test equipment is calibrated by measuring the intermodulation level of a reference load. Therefore, if the reference loads shows a level of  $-165 \text{ dBc}$ , the level of the measured products cannot be lower than  $-165 \text{ dBc}$ . It is then important to evaluate the difference between the measured values and the reference value.

# HYPERCELL®

## Selection guide of HYPERCELL® cables

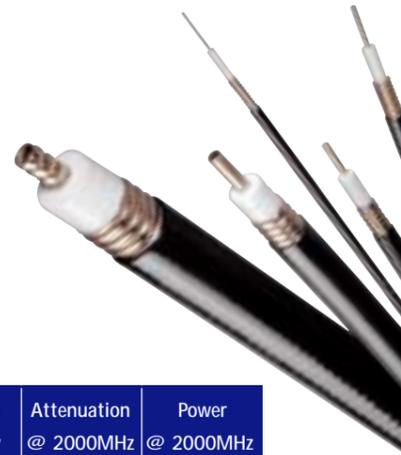


### Flexible cables

Cable type	Standard Jacket	Reference ACOME	Nominal size (")	Diameter on jacket (mm)	Min.Bend. Radius (mm)	Cable Weight (kg/m)	Maximum Frequency (GHz)	Attenuation @ 2000MHz (dB/100m)	Power @ 2000MHz (kW)
HPL50-1/4F	Black P.E	M 2930 Z	1/4	9.50	40	0.129	15.00	20.60	0.34
	LSOH	M 2932 Z	1/4	9.50	40	0.145	15.00	20.60	0.34
	HFR	M 5309 Z	1/4	9.50	40	0.145	15.00	20.60	0.34
HPL50-3/8F	Black P.E	M 2934 Z	3/8	11.50	50	0.185	12.00	15.15	0.45
	LSOH	M 2936 Z	3/8	11.50	50	0.204	12.00	15.15	0.45
	HFR	M 5310 Z	3/8	11.50	50	0.204	12.00	15.15	0.45
HPL50-1/2F	Black P.E	M 1473 Z	1/2	16.00	70	0.250	8.00	10.62	0.81
	LSOH	M 2831 Z	1/2	16.00	70	0.276	8.00	10.62	0.81
	HFR	M 5322 Z	1/2	16.00	70	0.276	8.00	10.62	0.81
HPL50- 5/8F	Black P.E	M 5038 Z	5/8	22.50	90	0.448	6.00	7.73	1.17
	LSOH	M 5039 Z	5/8	22.50	90	0.500	6.00	7.73	1.17
	HFR	M 5357 Z	5/8	22.50	90	0.500	6.00	7.73	1.17
HPL50-7/8F	Black P.E	M 1474 Z	7/8	27.75	120	0.598	5.00	6.13	1.63
	LSOH	M 2832 Z	7/8	27.75	120	0.650	5.00	6.13	1.63
	HFR	M 5323 Z	7/8	27.75	120	0.650	5.00	6.13	1.63
HPL50-1-1/4F	Black P.E	M 2937 Z	1-1/4	39.50	200	0.940	3.00	4.45	2.31
	LSOH	M 2938 Z	1-1/4	39.50	200	1.070	3.00	4.45	2.31
	HFR	M 5358 Z	1-1/4	39.50	200	1.070	3.00	4.45	2.31
HPL50-1-5/8F	Black P.E	M 2939 Z	1-5/8	50.00	300	1.448	2.50	3.80	2.81
	LSOH	M 2940 Z	1-5/8	50.00	300	1.600	2.50	3.80	2.81
	HFR	M 5359 Z	1-5/8	50.00	300	1.600	2.50	3.80	2.81
HPL50-2-1/4F	Black P.E	M 5040 Z	2-1/4	59.70	360	1.950	2.20	3.46	3.50

# HYPERCELL®

## Selection guide of HYPERCELL® cables



### SuperFlexible cables

Cable type	Standard Jacket	Reference ACOME	Nominal size (")	Diameter on jacket (mm)	Min.Bend. Radius (mm)	Cable Weight (kg/m)	Maximum Frequency (GHz)	Attenuation @ 2000MHz (dB/100m)	Power @ 2000MHz (kW)
HPL50-1/4SF	Black P.E	M 2929 Z	1/4	7.70	25	0.100	18.00	28.52	0.20
	LSOH	M 2931 Z	1/4	7.70	25	0.109	18.00	28.52	0.20
	HFR	M 5302 Z	1/4	7.70	25	0.109	18.00	28.52	0.20
HPL50-3/8SF	Black P.E	M 2933 Z	3/8	10.80	25	0.163	12.00	19.45	0.37
	LSOH	M 2935 Z	3/8	10.80	25	0.176	12.00	19.45	0.37
	HFR	M 5306 Z	3/8	10.80	25	0.176	12.00	19.45	0.37
HPL50-1/2SF	Black P.E	M 2839 Z	1/2	13.40	25	0.227	10.00	16.00	0.52
	LSOH	M 2830 Z	1/2	13.40	25	0.240	10.00	16.00	0.52
	HFR	M 5308 Z	1/2	13.40	25	0.240	10.00	16.00	0.52

### ExtraFlexible cables

Cable type	Standard Jacket	Reference ACOME	Nominal size (")	Diameter on jacket (mm)	Min.Bend. Radius (mm)	Cable Weight (kg/m)	Maximum Frequency (GHz)	Attenuation @ 2000MHz (dB/100m)	Power @ 2000MHz (kW)
HPL50-1/16XF	White PVC	M 5330 Z	1/16	2.80	15	0.013	18.00	94.00	0.041
	LSOH	M 5360 Z	1/16	2.80	15	0.015	18.00	94.00	0.041
	HFR	M 5331 Z	1/16	2.80	15	0.015	18.00	94.00	0.041
HPL50-1/4XF	White PVC	M 5300 Z	1/4	6.85	20	0.065	15.00	31.59	0.26
	LSOH	M 5361 Z	1/4	6.85	20	0.069	15.00	31.59	0.26
	HFR	M 5332 Z	1/4	6.85	20	0.069	15.00	31.59	0.26
HPL50-3/8XF	White PVC	M 5312 Z	3/8	10.10	25	0.106	12.00	19.30	0.41
	LSOH	M 5362 Z	3/8	10.10	25	0.111	12.00	19.30	0.41
	HFR	M 5333 Z	3/8	10.10	25	0.111	12.00	19.30	0.41