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Commercial Department
Kozloduy NPP EAD
3321, Kozloduy
BULGARIA

17.01.2023

N/Ref.: TEC-KNPP-001/23

SUBJECT: RESPONSE TO MARKET RESEARCH No. 50606

Dear Sirs:

In response to the Market Research No. 50606, titled "Supply of pearl probes / bobbin type for the control of eddy currents of steam generators type PGV-1000M", we hereby include, attached to this letter, our indicative proposal.

For any query you may have, please, contact Nicolás Moyano (nmoyano@tecnatom.es; + 34 616 417 827).

Sincerely.

Digitally signed by NICOLAS MOYANO DE LAS HERAS (2161)
Date: 2023.01.17 23:02:47 CET

Заличено на основание ЗЗЛД

Nicolás Moyano
Regional Commercial Director

tecnatom

INDICATIVE PROPOSAL FOR MARKET CONSULTATION No. 50606

1. Detailed description according to the technical specification

a. The technical characteristics of the proposed probes have been calculated for the material 08X18H10T, with diameter 16 mm y wall thickness of 1,5 mm, for frequencies 20 – 300 kHz, basic – 140 kHz.

b. The mechanical and electrical probes are manufactured with a Amphenol 4-pins male connector.

c. The probes are designed for the inspection of the tubes of PGV-1000M of Kozloduy NPP, until AVB#3 included.

d. The head of the probe is equipped with a centerer in order to minimize the "bouncing" of the probe. The duration of the centerers is the same as the duration of the probes.

e. The construction of the probe guarantees its recoil at a constant speed, without latching or extension.

f. The probes have impedance compatibility with the eddy current instruments available at Kozloduy NPP - TEDDY-4, M1Z-30, MIZ-80 y MIZ-85iD-2. It has been checked that the probes can work in any of this equipment.

g. The probes are clearly marked (serial number, diameter, etc.)

h. The probes are equipped with a core that, in case of failure, ensure that they can be withdrawn without residue.

i. The materials of the probes do not cause any damage in contact with the tubes. All the material in contact with the surface of the tube is Nylon. Certificates of the content of chlorine and fluoride are available.

j. Electrical properties of the probes are not altered by water or humidity. Cables and welds are protected with insulation and heat shrinkable sleeves. The probes are not intended to be used under water (immersion).

2. Indicative prices

Indicative prices are per the table below:

ID No.	Type of probe	Quantity	Unitary Price (€)	Total Price (€)
64105	Probe type Pearl 11,00 mm – FE110VMF16CB-	80	1.315 EUR	105.200 EUR
7917	Probe type Pearl 10.50 mm - FE105VMF16CB-	16	1.315 EUR	21.040 EUR
7918	Probe type Pearl 11.50 mm - FE115VMF16CB-	4	1.315 EUR	5.260 EUR

3. Delivery terms, warranty and documentation

a. Delivery: EXW Madrid, according to Incoterms 2020

b. Lead time: 20 – 25 weeks

c. Warranty: The design of the probe has been tested with equivalent operations than the introduction on a probe in a tube mock-up and an tappet 10D at a constant speed (entry + 90° curve + straight stretch + curve + vertex) with a warranty over 450 cycles.

d. Documentation: Certificate of Conformance

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Eddy current probes catalogue
Industrial and nuclear sector

Our wide experience as manufacturers of NDE products disposes an own design and the manufacturing of eddy current probes and sensors for sectors as energy, industrial, nuclear, aeronautical and automotive among others.
Along more than 60 years developing our activity, it has been day to day diversified the products parallel with the market trend.
Likewise, applications where our sensor and probes do inspections are diverse going through at the beginning with probes for tubes in exclusivity (steam generators and heat exchangers) to probes for more sectors like thermal plants, refinery, solar plants, iron and steel industry and more sectors that not only are limited to doing tube inspection. For certain applications, we counted on the experience, personnel and means adapted for the development of more complicated soundings to size to solve them inspection.
Tecnatom has an organization of Quality, that depends directly on the Main directorate, and that is composed by quality technicians, in exclusive dedication and credited like supervisors. The activity of Tecnatom is governed by a System of Quality approved by the Main directorate of the company and certified by AENOR regarding ISO 9001 rules.

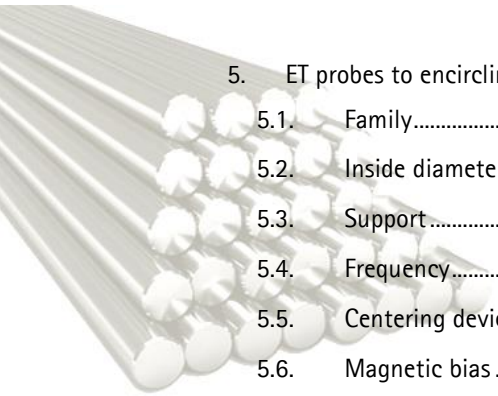
Eddy current probes are available in a wide variety of shapes and sizes. In fact, the main advantage in the ET inspection is that probes can be custom designed for a wide variety of applications. The eddy current probes are classified by the configuration and the coil's working mode. The configuration usually specifies to the support where the coil or coils are assembled to be better coupled to the interested testing area and the working mode to the technic used to that ends.

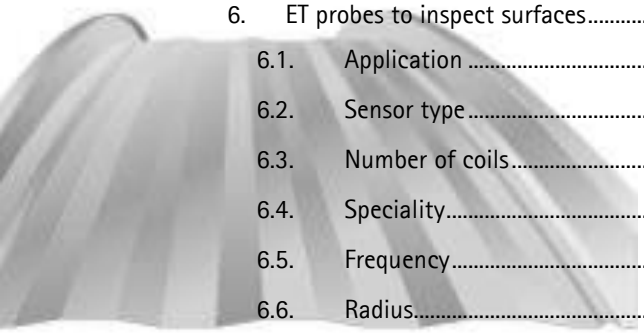
The present catalogue is structured as the following way:

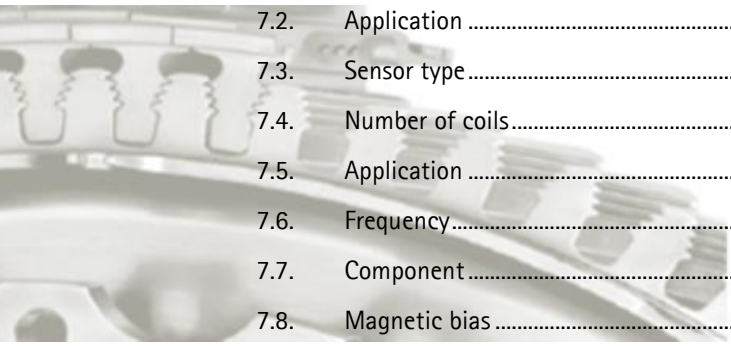
- *ET probes to inspect with Eddy current. It's distinguished the following techniques:*
  - *Bobbin probe*
  - *Rotating*
  - *Array and profilometry*

- *RFT probes (remote field testing) and NFT (near field testing) for tubes*
- *ET probes for rod inspection*
- *ET probes for surface inspection (Vessels, coatings, large components)*
- *ET probes to inspect pieces with specific geometry. The probe copies the piece shape.*

- ✓ *Products designed for their performance in nuclear environment has more strictly certifications and design processes and manufacturing more comprehensive so that products are marked as "nuclear product" in the reference guide (see page 48)*
- ✓ *Written letters in common colour specify the standard codes and in grey colour options not considered as standard it appears.*







ET tube inspection

The inspection of installed tubes in different heat-exchangers is performed with probes introduced by the inside surface of the tube (circular or "bobbin" coil type), therefore, necessary data to selecting a ET probe for tubes are:

- Tube diameter
- Thickness
- Material
- Length

Minimum data that allows to define a probe are: probe diameter, frequency and minimum length. In the following points is described with formulas and calculation tables to the diameter and frequency the way to obtain the parameters.
Regarding length a standard length holding on is recommended with 26 m or 32 m, however if that measures are not suitable to the customer needs or customer specifications they will manufacture regarding required measures. Suitable probe length is at least 4 meters greater than tube length to be inspect.
For that kind of probes, the poly shaft uses to be a nylon tube (TN) with 9,5 mm diameter and 1,8 mm thickness. Tubes with diameters less or equal than 10 mm the TN diameter will be 8, 7, 6 or 5 mm and as rule 1mm smaller than the probe's head diameter.

Probe diameter. The diameter of the probe head is calculated according to the fill-factor which is defined as the square of the ratio between the diameter of the head and the inside tube diameter:

$$FF = (Dp/ Di)^2$$

The higher the fill factor the higher the sensitivity of the probe, but also, the greater the difficulty to pass through certain constraints that can occur in the tube inside diameter because of bends, dents, deposits, etc. Considering the experience, a generic fill factor value of 0.85 is recommended. Set the fill factor and knowing the inside tube diameter, the probe head diameter can be obtained as:

$$Dp= Di * \sqrt{FF}$$

where:

- Dp = Probe head diameter
- Di = inside diameter of tube
- FF = Fill-Factor

Probe diameter (FF=0.85)		Tube thickness [mm]														
		3,4	3,05	2,77	2,41	2,11	1,83	1,65	1,47	1,24	1,07	0,89	0,81	0,71	0,65	0,56
Tube diameter OD [mm]	9,83	30	35	40	45	50	55	60	65	70	70	75	75	80	80	80
	12,7	55	60	65	75	80	85	85	90	95	95	100	100	105	105	105
	15,87	85	90	95	100	105	115	115	120	125	125	130	130	135	135	135
	19,05	115	120	125	130	135	140	145	150	155	155	160	160	165	165	165
	22,22	140	150	155	160	165	170	175	180	180	185	190	190	190	195	195
	25,4	170	180	185	190	195	200	205	205	210	215	220	220	220	220	225
	31,75	230	235	240	250	255	260	260	265	270	275	275	280	280	280	280
	38,1	290	295	300	305	310	320	320	325	330	330	335	335	340	340	340
	50,8	405	410	415	425	430	435	440	440	445	450	450	455	455	455	460

Table 1 Recommended probe diameters for ET and FF = 0.85

Probe main frequency. The main frequency is calculated from the formula:

$$f = 6.4 * \rho / t^2$$

, in which is obtained a lag between 50 ° and 120 ° between the signal of the through hole and the signal of the OD 4-hole 20% depth, where:

- *f = Frequency in KHz*
- *ρ = Resistivity in μΩcm*
- *t = Tube wall thickness in mm*

Inspection frequency [KHz]		Material resistivity [μΩcm]									
		ADMIRALTY	BRASS	Cu-Ni 90-10	Cu-Ni 70-30	TITANIUM	MONEL	INOX 304	INOX 316	INCONEL 600	
		6,2	7	19	35	48,6	58	72	74	98	
Thickness [mm]	0,508	154	174	471	868	1205	1438	1786	1835	2430	VF Ultra high Frequency
	0,711	78	89	241	443	615	734	912	937	1241	
	0,813	60	68	184	339	471	562	697	717	949	
	0,890	50	57	154	283	393	469	582	598	792	
	1,067	35	39	107	197	273	326	405	416	551	AF High Frequency
	1,092	33	38	102	188	261	311	386	397	526	
	1,245	26	29	78	145	201	239	297	306	405	
	1,473	18	21	56	103	143	171	212	218	289	MF Medium Frequency
	1,651	15	16	45	82	114	136	169	174	230	
	1,830	12	13	36	67	93	111	138	141	187	
	2,110	9	10	27	50	70	83	104	106	141	BF Low Frequency
	2,410	7	8	21	39	54	64	79	82	108	
	2,600	6	7	18	33	46	55	68	70	93	
	2,800	5	6	16	29	40	47	59	60	80	
	3,100	4	5	13	23	32	39	48	49	65	
	4,370	2	2	6	12	16	19	24	25	33	
	5,500	1	1	4,0	7	10	12	15	16	21	EF Extra low Frequency
		IF Infra low frequency									

Table 2 Recommended inspection frequencies for conductive tubes

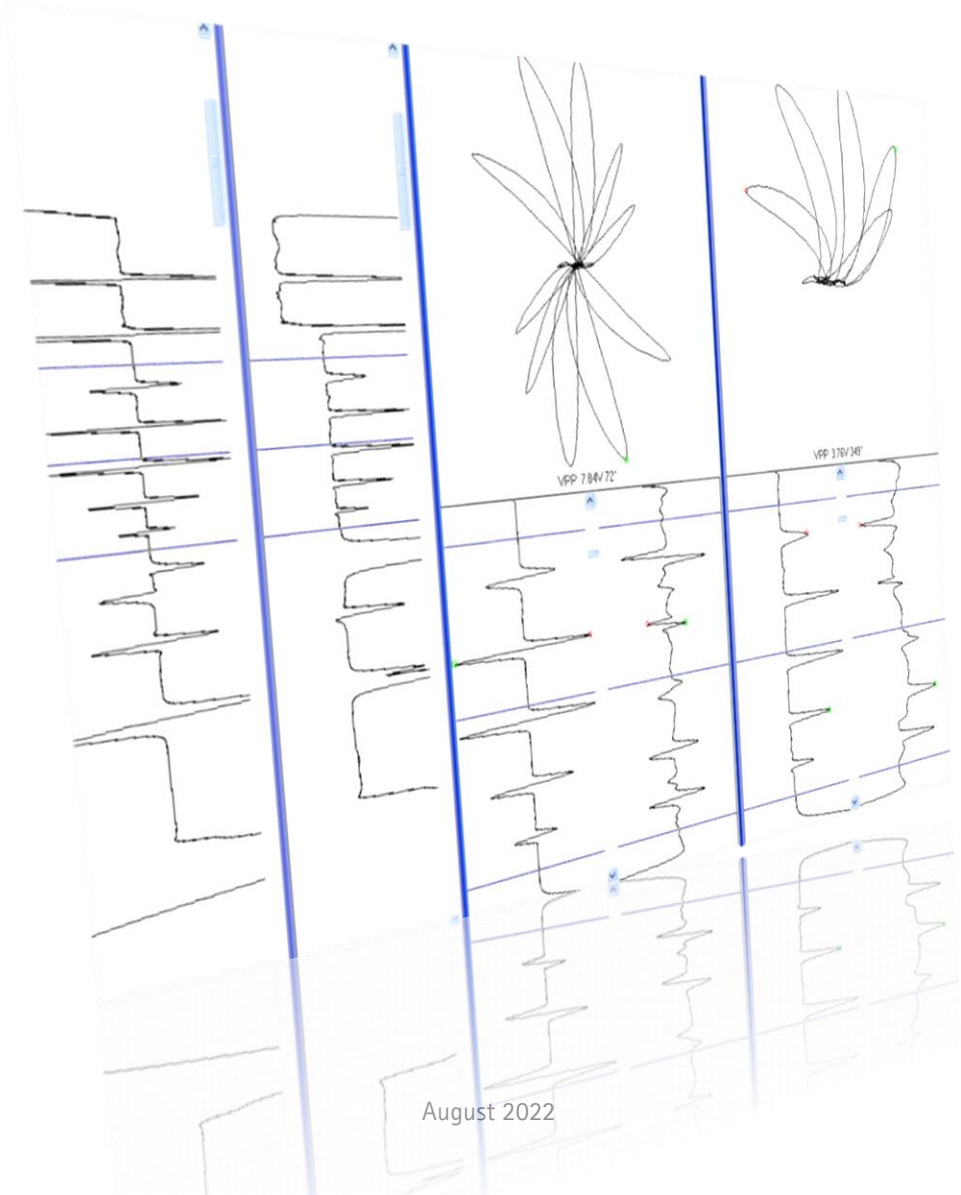
ET tube inspection

Bobbin probe

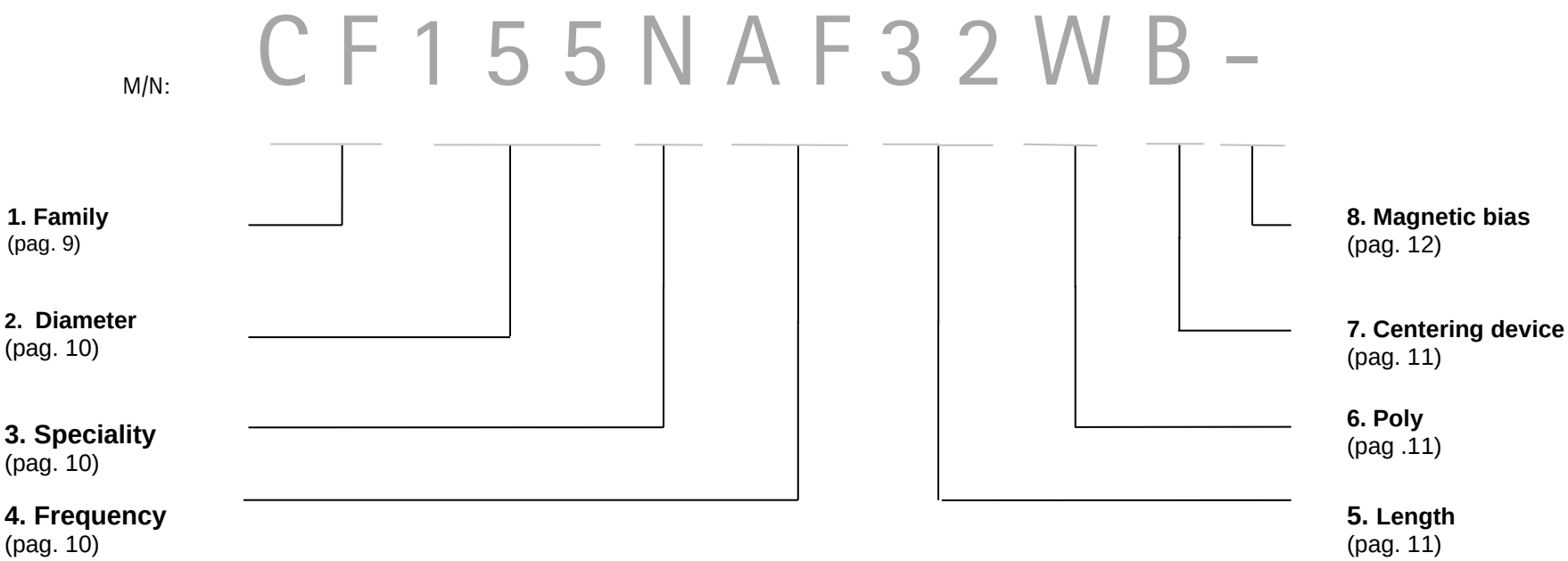
The following section contains all probes to inspect installed tubes. Usually are common installed in components like heat exchangers. Some examples are shown:

- Steam generators
- Condensers
- Heaters
- Re-heaters
- Refrigerators
- Moisture separators
- Etc

The inspection is carried out with a probe through the inside of each tube. The method consists in create Eddy current in the material to inspect through an alternating magnetic field generated by the coils of the probe and excited by an oscillator. The eddy current test analyses the influence of the different parameters in the sample conductivity thanks to the electromagnetic induction phenomena.



1. ET probe codification for tubes. Bobbin coil



Probe examples:
CF155NAF32WB- = Probe with flexible head for steam generators. 15.5 mm of diameter, common application and high frequency. Poly length 32 meters and poly type is nylon tube with diameter 9.5 mm, centering device is crossbow and without magnetic bias.
SR205NBF20Z-- = Standard straight and partialy protected probe with 20.5 mm of diameter. Common application and low frequency. Poly length 20 meters and poly type nylon tube with 10 millimetres of diameter and without centering devices or magnetic bias.

1.1. Family

- The main function is to describe the head type of the probe:

Code	Description	General application
SN	Standard nylon straight	Straight tubes
SR	Standard straight partial protected	Straight tubes
SP	Standard protected	Straight tubes
FG	Flexible, steam generators	Bent tubes
FE	Flexible, special design	Bent tubes
F2	Flexible, combined	Bent tubes
SC	Flexible, protected	Bent tubes
SX	Flexible for air pusher system	Bent tubes + AirTp
CF	Flexible head, steam generators	Bent tubes
SA	Air driven	Bent tubes
TH	Thimbles	Bent tubes

Code example: FG155NAF32WB-

Probes for straight tubes

They are used to inspect straight tubes with ET of any conductivity and non-ferromagnetic material or lightly ferromagnetic and tube thickness up to 3 mm.

SN family

SR family

SP family

Features

- Sensor: Two circumferential coils parallel between them and perpendicular to the axis of the tube.
- Inspection technique: Impedance in absolute and/or differential mode.
- Dimensions: Diameter ranges from 5 mm up to 50 mm in step of 0.5 mm. Customer specifications are also accepted.
- Mechanical: Rigid head for inspection of straight tubes.
- Connector: AMPHENOL male four-pin as standard or any other connector with connection diagram supplied by the customer.
- Poly length: Standard 26 meters. Customer specifications are also accepted

Probes to inspect 'U' bended tubes

They are used to inspect 'U' bended tubes with ET of any conductivity and non-ferromagnetic material or lightly ferromagnetic and tube thickness up to 3 mm.

FG family

FE family

CF family

TH family

SC family

SX Family

Features

- Two circumferential coils parallel between them and perpendicular to the axis of the tube.
- Inspection technique: Impedance in absolute and/or differential mode.
- Dimensions: diameter range from 9 mm up to 25 mm in step of 0.5 mm. Customer specifications is also accepted.
- Mechanical characteristics: Flexible head for inspection of U bend tubes.
- Connector: AMPHENOL male four-pin as standard or any other connector with connection diagram supplied by the customer.
- Poly length: Standard 32 and 26 meters. Customer specifications are also accepted.

1.2. Diameter

See Table 1. Recommended probe diameters for ET and FF=0.89.

- Diameter in generally is expressed in tenths of millimetres with increments of 0.5 mm although it's possible to order any measure of diameter. For diameters not showed in the 'table 2', is needed to use the formula at the beginning of this part.

Code	Description
300	Probe diameter 30 mm
...	...
210	Probe diameter 21 mm
205	Probe diameter 20.5 mm
...	...
155	Probe diameter 15.5 mm
...	...
100	Probe diameter 10 mm

Code example: FG155NAF32WB-

1.3. Speciality

Code	Description
N	Normal
P	Long neck / Small radius of tube bending
V	Probes for WWER steam generators
M	Modified
E	Customer specification or special measures
C	Neck for horizontal heat exchangers (FC)

Code example: FG155NAF32WB-

1.4. Frequency

Code	Description	Frequency
VF	Ultra high frequency	600-2500 KHZ
AF	High frequency	350-600 KHZ
MF	Medium frequency	150-350 KHZ
BF	Low frequency	50-150 KHZ
EF	Extra low frequency	10-50 KHZ
IF	Infra low frequency	0.2-10 KHZ
-	N/A	-

Code example: FG155NAF32WB-

1.5. Length

Code	Description
47	47 m length
...	...
32	32 m length
...	...
26	26 m length
...	...
20	20 m length
...	...
16	16 m length
...	...
-	Does not apply

Code example: FG155NAF32WB-

1.6. Poly

Code	Description
U	Nylon tube 3 mm ø OD
H	Nylon tube 4 mm ø OD
R	Nylon tube 5 mm ø OD
X	Nylon tube 6 mm ø OD
S	Nylon tube 7 mm ø OD
N	Nylon tube 7 mm ø OD and 1,5 mm thickness
Y	Nylon tube 8 mm ø OD
W	Nylon tube 9.5 mm ø OD and 1,8mm thickness
Z	Nylon tube 10 mm ø OD and 1 mm thickness
T	Nylon tube 12 mm ø OD and 1m mm thickness
P	Nylon tube 12 mm ø OD and 2 mm thickness
A	Metal jacket of 4.9 mm ø OD
C	Metal jacket of 7 mm ø OD
-	Without poly or jacket

Code example: FG155NAF32WB-

1.7. Centering device

- Orders have to be good specified with the inside diameter of the tube to be inspected. It will also be possible to order a specific diameter for the centering device.

Code	Description
B	Centering device type crossbow
-	Without centering device

Code example: FG155NAF32WB-

SN probe without centering device

SN probe with centering device

1.8. Magnetic bias

Code	Description
I	Partial magnetic bias
S	Full magnetic bias
-	Without magnets

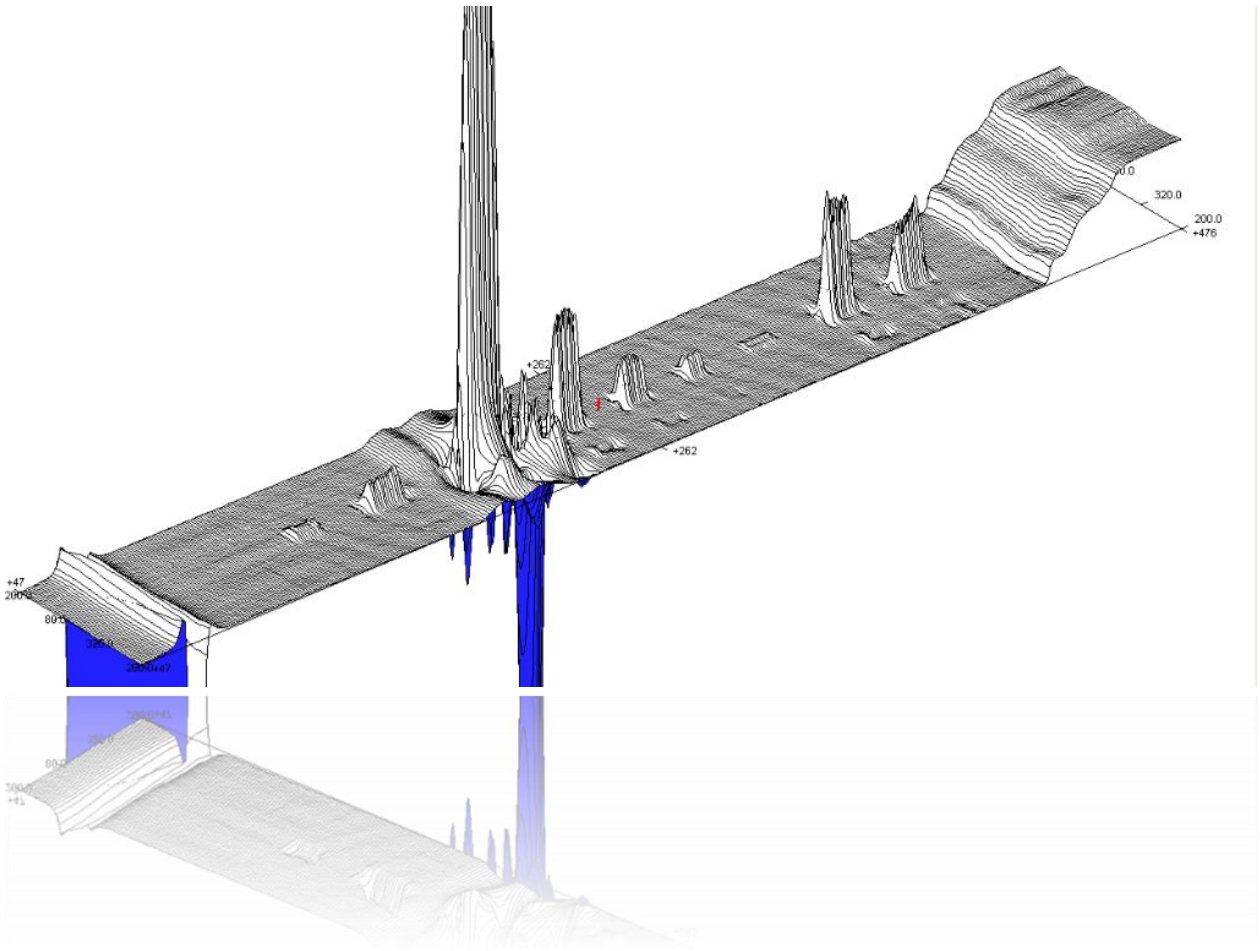
Code example: FG155NAF32WBI

SN probe with partial magnetic bias

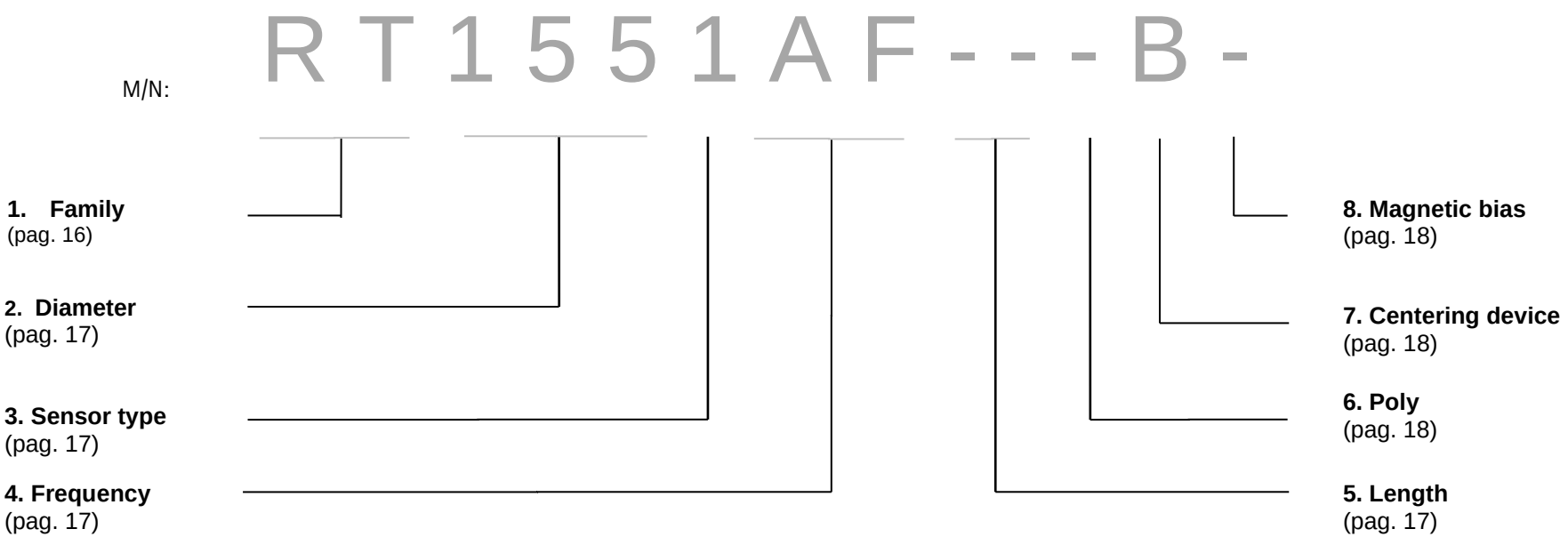
ET tube inspection

Rotating probe

Such probes are used to inspect tubes by the inside in the way that the sensor is turning inside and describing a helicoidally trajectory that cover the whole surface to inspect with an approximated pitch of 1 mm. This trajectory is obtained in combination to a rotating movement provided by the "motor" and a tube axis direction displacement provided by the probe pusher. ET sensors are assembled in the head probe. These sensors are punctual coils called pancake or cross-coil and it can be assembled with one ore some. Through a specific software a three-dimensional representation and C-Scan can be done which allows in an intuitive way to analyse the flaw type and to define the axial and circumferential measures. Et signal analysis allows to know the depth flaw and determine if it is in the inside surface of the tube or external surface. The common extraction speed of this probes is around 10 mm/s.
The probe diameter is calculated in the same way that ET probes to inspect tubes although the inspection coil is in the most of applications in contact to the tube surface. It's recommended to use FF parameter around 0.85 approximately.



2. ET probe codification for tubes. Rotating probe



Probe examples:
RT1551AF---B-= ET rotating probe with 15.5 mm of diameter and 3 shoes. Eddy sensors = (Pancake 3mm + 1 Cross-coil) + bobbin coil. The working frequency is medium frequency and is provided with centering devices crossbow type.
MR155N--20Z--= Motor for rotating heads with 15.5 mm of diameter at one speed of 1200 rpm. Poly length is 20 meters and the material is nylon with 10 mm of diameter by 1 mm of thickness.

2.1. Family

- The main function of that code is to describe the type of rotating application of the probe.

Code	Description
RT	Rotating probe for tubes
PI	Rotating probe for vessels
RU	Rotating probe for 'U' bends
MR	Motor
RC	Collector rotating probe

Code example: RT1551AF---B-

RT family

PI family

MR family

RC family

2.2. Diameter

- Diameter in generally is expressed in tenths of millimetres with increments of 0.5 mm although it's possible to order any measure of diameter. The sensor is usually in contact with the tube inside surface increasing the sensibility to small defects. For diameters not showed in the 'table 2', is needed to use the formula at the beginning of this part.

Code	Description
180	Head diameter 18 mm
…	…
155	Head diameter 15.5 mm
…	…
090	Head diameter 9 mm

Code example: RT155**1**AF---B-

2.3. Sensor type

Code	Description
N	Without sensor, only 1200 rpm motor
V	Pick-up differential for WWER
0	3 Shoes (1 Pancake 2mm + 1 Pancake 3mm + 1 Cross-coil)
1	3 Shoes (1 Pancake 3mm + 1 Cross-coil) + bobbin coil
2	1 Shoe (1 B. Cross-coil)

Code example: RT1551AF---B-

2.4. Frequency

Code	Description	Frequency
VF	Ultra frequency	700-2500 KHZ
AF	High frequency	350-700 KHZ
MF	Medium frequency	50-350 KHZ
BF	Low frequency	30-50 KHZ
EF	Extra frequency	10-30 KHZ
IF	Infra frequency	0.2-10 KHZ

Code example: RT1551AF---B-

2.5. Length

Length		
Code	Motor	Head
25	25 m	2.5 m
10	10 m	1 m
09	9 m	0.9 m
…	…	
05	5 m	0.5 m
…	…	
-	N/A	N/A

Code example: MR155N—20Z--

2.6. Poly

Code	Description
U	Nylon tube 3 mm ø OD
R	Nylon tube 5 mm ø OD
X	Nylon tube 6 mm ø OD
S	Nylon tube 7 mm ø OD
Y	Nylon tube 8 mm ø OD
W	Nylon tube 9.5 mm ø OD and 1.8mm thickness
Z	Nylon tube 10 mm ø OD and 1 mm thickness
T	Nylon tube 12 mm ø OD and 1m mm thickness
P	Nylon tube 12 mm ø OD and 2 mm thickness
A	Metal jacket of 4.9 mm ø OD
C	Metal jacket of 7 mm ø OD
-	Without poly or jacket

Code example: MR155N--20Z–

2.7. Centering device

Code	Description
B	Centering device type crossbow
K	Centering with spring loaded steel ball
-	without centering device

Code example: RT1551AF---B–

2.8. Magnetic bias

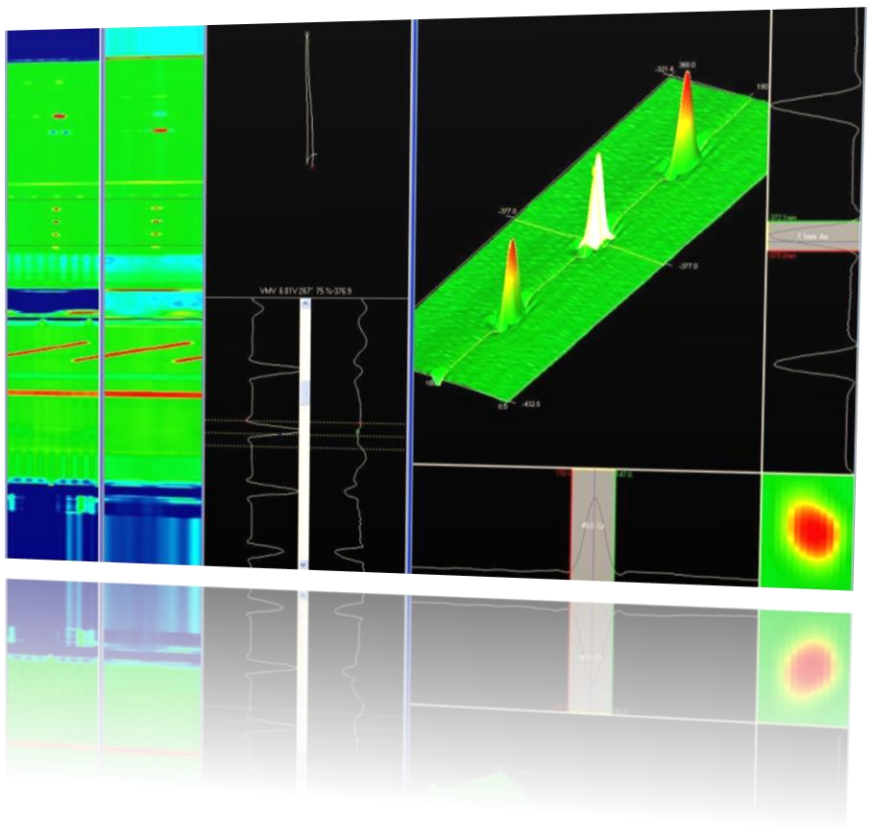
Code	Description
I	Partial magnetic saturation
-	Without magnets

Code example: RT1551AF---BI

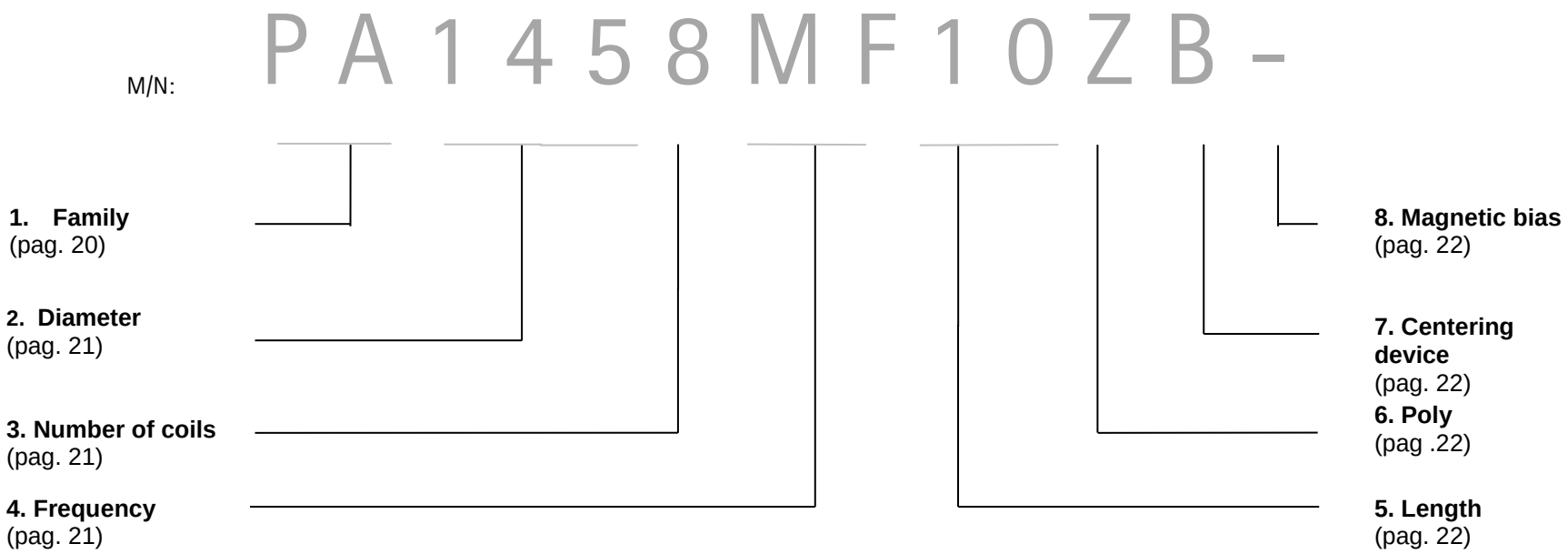
ET tube inspection

Probes for techniques as profilometry and array

Array and profilometry probes are characterized by the assembly in the same probe a specific number of equal elements. The difference consists in the target points or the information that it's expected to obtain.
With the array probe, information about the tube is obtained like the rotating probe but with the big advantage face to rotating probe that the inspecting head inspects the tube by the inside surface and don't do any physical movements of rotation or wearing, it only does movement along the tube in order 50 times faster than rotating coil.
Profilometry probe has the target to measure tube deformation. Both, aside the coil windings, use to carry a circular bobbin coil couple.
As in the case of ET conventional, each element is excited with an oscillator and its analysed changes in their impedance with an eddy current instrument and a multiplexer in case if needed plus the adapter. Each element is excited with a specific sequence through the oscillator generating this way an electromagnetic field which will be induced in the material as eddy currents. Variations on impedance of each element are affected by changes in the sample conductivity produced by flaws, deposits, corrosion, etc.
Sensor elements to be used could have some typologies as pancake coil, printed circuits, etc. Also in relation, the electronics connected it's possible to choose the working mode like absolute, differential, pick-up, etc.



3. ET probe codification for tubes. Array and profilometry probes



Probe examples:
PA1458MF10ZB- = ET probe pancake array type with 14.5 mm of diameter. 8 windings for the application at médium frequency. Poly type nylon 10x1 mm with 10 meters length. Centering devices crossbow type.
PR1558MF10ZB- = ET probe pancake array for profilometry type with 15.5 mm of diameter. 8 windings for the application at médium frequency. Poly type nylon 10x1 mm with 10 meters length. Centering devices crossbow type.

3.1. Family

- The main function of this code is give the type of array used:

Code	Description
PA	Pancake Array
PR	Profilometry Array
TP	Array with electronics inside the head *(Tprobe)*
AS	Array with electronics in poly or connector

Code example: PR1558MF10ZB-

PA family

PR family

TP family

AS family

3.2. Diameter

- Diameter in generally is expressed in tenths of millimetres with increments of 0.5 mm although it's possible to order any measure of diameter. For diameters not showed in the 'table 2', is needed to use the formula at the beginning of this part.

Code	Description
220	22 mm head diameter
...	...
185	18.5 mm head diameter
155	15.5 mm head diameter

Code example: PR155 8MF10ZB-

3.3. Number of coils

Code	Description
2	2x1 coil windings
3	3x1 coil windings
4	4x1 coil windings
...	...
8	8x1 coil windings
...	...
A	16x2 elements
B	8x2 elements

Code example: PR1558 MF20ZB-

3.4. Frequency

Code	Description	Frequency
VF	Ultra frequency	700-2500 KHZ
VC	Ultra frequency + bobbin coil	700-2500 KHZ
AF	High frequency	350-700 KHZ
AC	High frequency + bobbin coil	350-700 KHZ
MF	Medium frequency	50-350 KHZ
MC	Medium frequency + bobbin coil	50-350 KHZ
BF	Low frequency	30-50 KHZ
BC	Low frequency + bobbin coil	30-50 KHZ
EF	Extra frequency	10-30 KHZ
EC	Extra frequency + bobbin coil	10-30 KHZ
IF	Infra frequency	0.2-10 KHZ
IC	Infra frequency + bobbin coil	0.2-10 KHZ

Code example: PR1558 F20ZB-

3.5. Length

Code	Description
32	32 m length
...	...
26	26 m length
...	...
20	20 m length
...	...
16	16 m length
...	...

Code example: PR1558MF20ZB-

3.6. Poly

Code	Description
U	Nylon tube 3 mm ø OD
R	Nylon tube 5 mm ø OD
X	Nylon tube 6 mm ø OD
S	Nylon tube 7 mm ø OD
Y	Nylon tube 8 mm ø OD
W	Nylon tube 9.5 mm ø OD and 1.8mm thickness
Z	Nylon tube 10 mm ø OD and 1 mm thickness
T	Nylon tube 12 mm ø OD and 1m mm thickness
P	Nylon tube 12 mm ø OD and 2 mm thickness
N	Nylon tube 7 mm ø OD and 1.5 mm thickness
A	Metal jacket of 4.9 mm ø OD
C	Metal jacket of 7 mm ø OD
-	Without poly or jacket

Code example: PR1558MF20ZB-

3.7. Centering device

Code	Description
B	Centering device type crossbow
K	Centering with spring loaded steel ball
-	without centering device

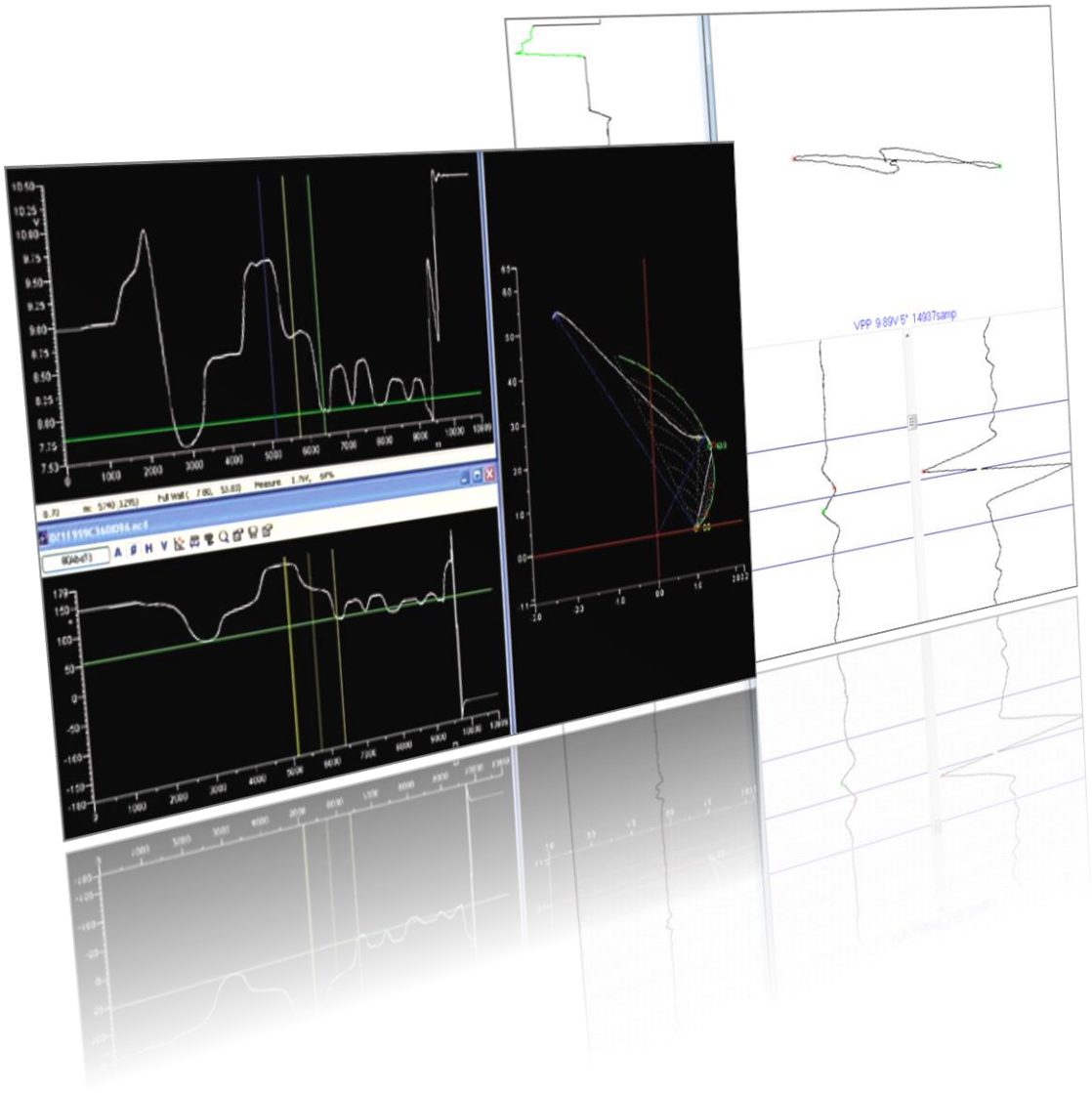
Code example: PR1558MF20ZB-

3.8. Magnetic bias

Code	Description
I	Partial magnetic saturation
-	Without magnets

RFT tube inspection

The technique of remote field testing is a type of non-destructive testing whose objective is to find defects in ferromagnetic tubes from the inside surface. The eddy current technique conventional for this type of tubes, presents some problems for its inspection. The basic probe is made up of an emitting coil (well-known like transmitter) that sends a signal to the detector (well-known like receiver). The transmitter is excited with alternating current that will create the corresponding alternating magnetic field. This field will travel through the tube and will continue by outside him. The detector located in the tube and separated between 2 and 3 distances diameter of tube diameter, will detect that magnetic field that when arriving it has crossed 2 times the wall of tube and its external surface.
RFT probes use to be assembled with emitter and receiver, one emitter and 2 receivers or two emitters and two receivers. Tecnatom probes are manufactured always by two emitters and two receivers. From the eddy current instrument, it's possible to choose anyone else to work in every descripted working mode.



Probe diameter. Diameter of the probe head is calculated in relation to the filling factor (FF) which is calculated as the square of diameter of the head of the probe between inside diameter of the tube.

$$FF = (Dp/ Di)^2$$

The higher the fill factor the higher the sensitivity of the probe, but also, the greater the difficulty to pass through certain constraints that can occur in the tube inside diameter as a result of bends, dents, deposits, etc. Considering the experience, a generic fill factor value of 0.80 is recommended. Set the fill factor and knowing the inside tube diameter, the probe head diameter can be obtained as:

$$Dp= Di*\sqrt{FF}$$

where:

- Dp = Probe head diameter
- Di = Inside diameter of tube
- FF = Fill-Factor

RFT

Probe diameter (FF=0.80)		Wall tube thickness [mm]																
		5,5	4,37	3,1	2,8	2,6	2,41	2,11	1,83	1,651	1,473	1,245	1,092	1,067	0,89	0,813	0,711	0,508
Tube OD diameter [mm]	9,83	-	-	-	-	-	-	-	-	-	060	065	065	065	070	070	075	075
	12,7	-	-	-	060	065	070	075	080	080	085	090	090	090	095	095	100	100
	15,87	-	060	085	090	095	095	100	105	110	115	115	120	120	125	125	125	130
	19,05	070	090	110	120	120	125	130	135	140	140	145	150	150	150	155	155	160
	22,22	100	120	140	145	150	155	160	165	165	170	175	175	175	180	180	185	185
	25,4	125	145	170	175	180	180	185	190	195	200	200	205	205	210	210	210	215
	31,75	185	205	225	230	235	240	245	250	250	255	260	260	260	265	265	270	270
	38,1	240	260	285	290	290	295	300	305	310	310	315	320	320	320	325	325	330
	50,8	355	375	395	400	405	410	415	420	420	425	430	430	435	435	435	440	445

Table 3 Recommended diameter codes for RFT probes and fill-factor = 0.80

NFT

Probe diameter (FF=0.89)		Wall tube thickness [mm]														
		3,4	3,05	2,77	2,41	2,11	1,83	1,65	1,47	1,24	1,07	0,89	0,81	0,71	0,65	0,56
Tube OD diameter [mm]	9,83	-	-	-	-	-	055	060	065	065	070	075	075	075	080	080
	12,7	055	060	065	070	080	085	085	090	095	095	100	100	105	105	105
	15,87	085	090	095	100	105	115	115	120	125	125	130	130	135	135	135
	19,05	115	120	125	130	135	145	145	150	155	155	160	160	165	165	165
	22,22	145	150	155	160	165	175	175	180	185	185	190	190	195	195	195
	25,4	175	180	185	190	195	205	205	210	215	215	220	220	225	225	225
	31,75	235	240	245	250	255	265	265	270	275	275	280	280	285	285	285
	38,1	295	300	305	310	315	320	325	330	335	335	340	340	345	345	345
	50,8	415	420	425	430	435	440	445	450	455	455	460	460	465	465	465

Table 4 Recommended diameter codes for NFT probes and fill-factor = 0.89

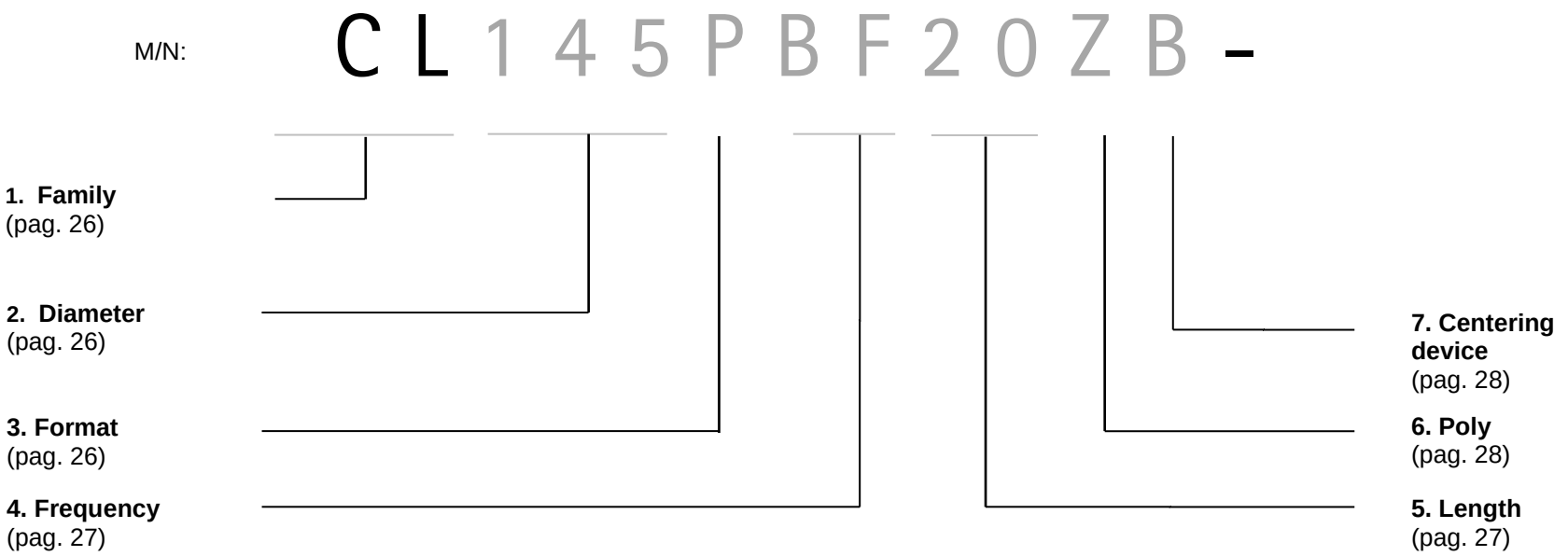
Main frequency: It's calculated through 3 ranges. To achieve the most adequate is needed to know the magnetic permeability of the tube and the thickness of it:

- Tube permeability - The higher the permeability, the lower inspection frequency to use.
- Tube thickness – The higher the thickness, the lower frequency to use.

		Tube thickness		
		<1mm	1-2mm	>2mm
Tube magnetic permeability	high	BF	BF	BF
	medium	MF	MF	BF
	low	AF	AF	MF

- Connector: Amphenol male 14 pin as standard or any other connector with connection diagram supplied by the customer.

4. RFT probe codification for tubes. Remote field testing



Probe examples:
CL130RBF20Z-- = RFT probe for tubes with a dimeter of 13 mm and built-in amplifier in the head without protection. Operative frequency is low frequency and poly type is 20 meters length with a nylon tube type 10x1 without centering devices or magnetic bias.
CL145PBF20ZB- = RFT probe for tubes with a dimeter of 14.5 mm and built-in amplifier in the head with protection. Operative frequency is low frequency and poly type is 20 meters length with a nylon tube type 10x1 with centering devices and wihout magnetic bias.

4.1. Family

- The inspection technique to the ferromagnetic tube goes pointed with the following codes:

Código	Descripción
CL	RFT probe. Remote field testing
CC	NFT probe. Near field testing

Code example: CC130PBF20Z--

4.2. Diameter

- Diameter is expressed in tenths of millimetres with increments of 0,5 mm. For tube diameters which could not appear in the table, is needed to use the previous formula described at the beginning of this part.

Code	Description
300	30 mm probe diameter
...	...
100	10 mm probe diameter

Code example: CL130PBF20Z--

4.3. Format

Code	Description
N	Straight without amplifier
R	Straight with amplifier
F	Flexible with amplifier
P	Protected with amplifier
E	Special measures. (diameter below than 10mm or greater than 30mm, amplifier built in the connector.)

Code example: CL130PBF20Z–

R format

P format

F format

Boiler type (E)

4.4. Frequency

- In order to define the frequency to which it will work the probe is needed to enter the following table being known the parameters permeability and thickness of tube seen in the headed one this section.

Code	Description	Frequency
AF	High frequency	15000-30000 HZ
MF	Medium frequency	1000-15000 HZ
BF	Low frequency	20-1000 HZ

Code example: CL130PBF20Z—

4.5. Length

Code	Description
32	32 m length
…	…
26	26 m length
…	…
20	20 m length
…	…
16	16 m length
…	…

Code example: CL130PBF20Z-

4.6. Poly

Code	Description
U	Nylon tube 3 mm ø OD
R	Nylon tube 5 mm ø OD
X	Nylon tube 6 mm ø OD
S	Nylon tube 7 mm ø OD
Y	Nylon tube 8 mm ø OD
W	Nylon tube 9.5 mm ø OD and 1.8mm thickness
Z	Nylon tube 10 mm ø OD and 1 mm thickness
T	Nylon tube 12 mm ø OD and 1m mm thickness
P	Nylon tube 12 mm ø OD and 2 mm thickness
A	Metal jacket of 4.9 mm ø OD
C	Metal jacket of 7 mm ø OD
-	Without poly or jacket

Code example: CL130PBF**Z**--

4.7. Centering device

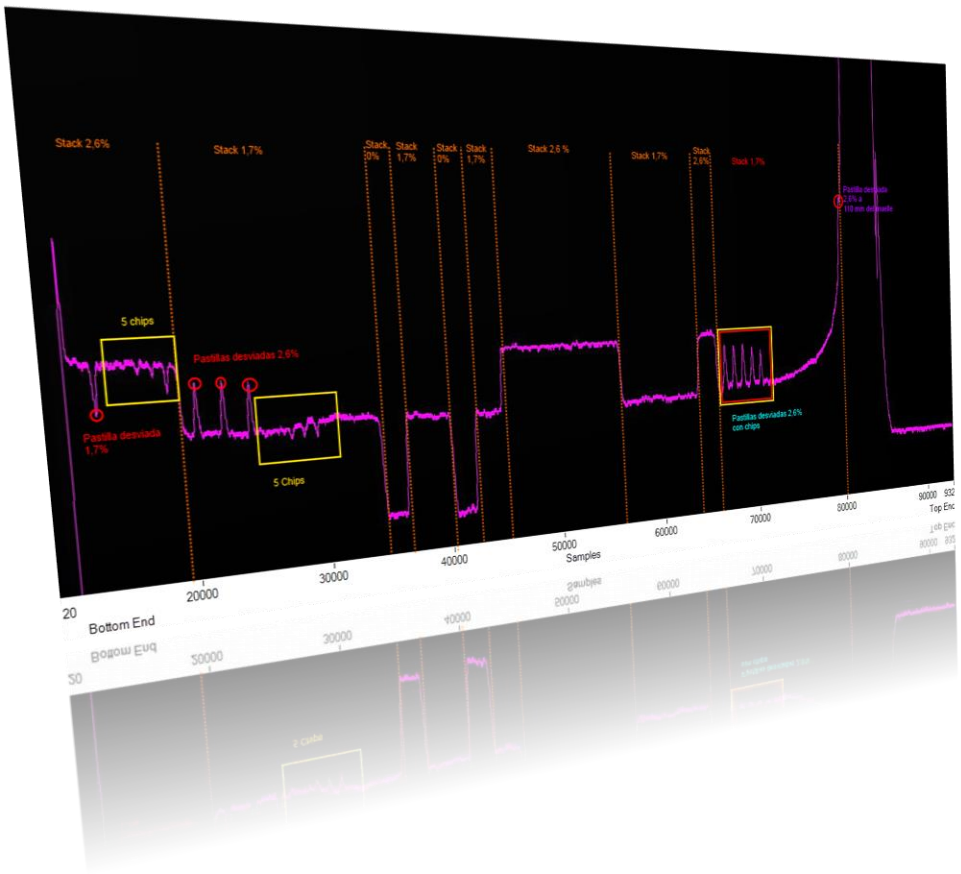
- Orders have to be good specified with the inside diameter of the tube to be inspected. It will also be possible to order a specific diameter for the centering device.

Code	Description
B	Centering device type crossbow
K	Centering with spring loaded steel ball
-	Without centering device

Code example: CL130PBF20Z**-**-

ET rod inspection. Encircling probes

In the inspection of rods and tubes by the outside the form of the ET sensor varies with respect to probes that inspect tubes by the inside surface. In these cases, the probe surrounds to the product by the outside. In most of the cases the probe remains immovable and is the product the one that journeys throughout the probe. The inspection techniques can be different based on the flaws type that is hoped to detect. The working mode can be absolute, differential or pick-up. Upon some cases, it's profitable to saturate magnetically the material by diverse reasons like ferromagnetism, deposits etc to discriminate these effects. Like of any probe of ET, the method of inspection it consists of inducing the eddy currents in the material to inspect thanks to an alternating magnetic field generated by a solenoid excited by an oscillator. The induced currents analyse the influence of the different parameters in the conductivity from the samples with the phenomenon of the electromagnetic induction.



Probe diameter. Diameter of the probe is calculated in relation to the filling factor (FF) which is defined as the square between outer diameter of the tube or rod and the sensor diameter:

$$FF = (Do/ Dp)^2$$

The higher the fill factor the higher the sensitivity of the probe although also it increases the difficulty to the passage of the bar through the probe with certain constrictions that can be produced like dents, deposits, corrosion... Considering the experience a generic value of 0.85 is recommended. Fixing the FF and knowing diameter outer of the bar, diameter of the probe it is possible to be obtained like the following formula:

$$Dp= Do /\sqrt{FF}$$

donde:

- *Dp = Probe diameter*
- *Do = Outside diameter of the rod or bar to be inspected*
- *FF = Fill-Factor*

Inside diameter of the probe		Fill factor			
		0,9	0,88	0,85	0,8
Outside diameter of rod or tube[mm]	3	30	30	35	35
	4	40	45	45	45
	6	65	65	65	65
	7	75	75	75	80
	8	85	85	85	90
	9	95	95	100	100
	10	105	105	110	110
	10,3	110	110	110	115
	10,77	115	115	115	120
	12	125	130	130	135
	13	135	140	140	145
	13,7	145	145	150	155
	14	150	150	150	155
	15	160	160	165	170
	16	170	170	175	180
	17	180	180	185	190
	17,1	180	180	185	190
	19,05	200	205	205	215
	21,3	225	225	230	240
	24	255	255	260	270
	25	265	265	270	280
	26,7	280	285	290	300
	33,4	350	355	360	375
	42,2	445	450	460	470
	48,3	510	515	525	540
	60,3	635	645	655	675
	73	770	780	790	815
	88,9	935	950	965	995

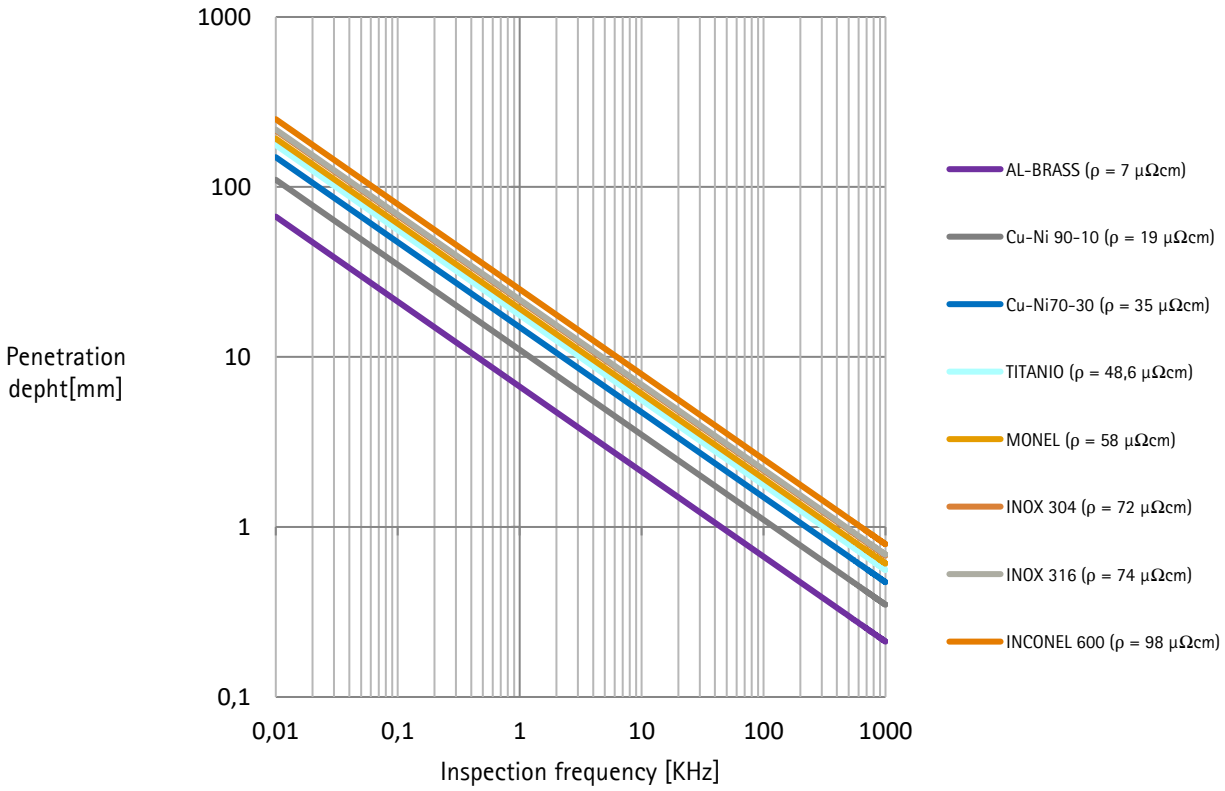
Table 4 Recommended probe diameter for rods based on the fill factor

Probe main frequency. The main frequency is calculated from the formula:

$$f = 6.4 * \rho / t^2$$

, in which is obtained a lag between 50 ° and 120 ° between the signal of the through hole and the signal of the OD 4-hole 20% depth, where:

- f = Frequency in KHz
- ρ = Resistivity in μΩcm
- t = Tube wall thickness in mm



➢ The frequency in the graph may variate in the case of solid rods.

5. ET probe codification for rods. Encircling probes

M/N: B A 1 5 5 N A F - - - B -

1. Family
(pag. 34)

2. Inside diameter
(pag. 35)

3. Support
(pag. 35)

4. Frequency
(pag. 35)

8. Magnetic bias
(pag. 36)

7. Centering device
(pag. 35)

Probe examples:
BA107CAF-----= ET probe for rods with inside diameter of 10.7 mm and circular support to work at high frequency
GA160NIF----S= ET probe for rods and gadolinium concentration measurement. 16mm of diameter and fixed support to work at infra frequency. Magnetic bias for full magnetic saturation.

5.1. Family

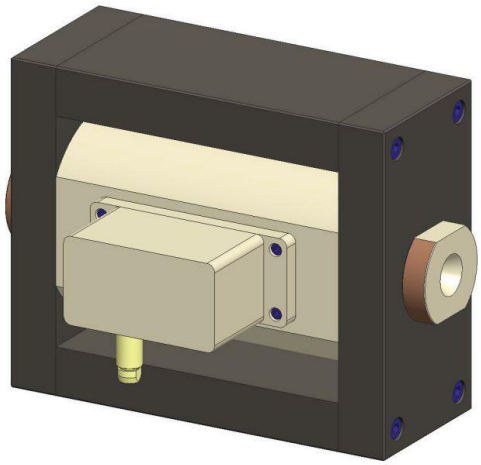
- The main function of that codes is to indicate the type of probe:

Code	Description
BA	ET probe for rods or tubes by the outside
GA	Probe for measurement of %Gadolinium in rods

Code example: GA120NIF----S

BA family with fixed support

BA family with circular support



GA family

5.2. Inside diameter

Code	Description
500	50 mm probe diameter
...	...
210	21 mm probe diameter
205	20.5 mm probe diameter
...	...
155	15.5 mm probe diameter
...	...
050	5 mm probe diameter

Code example: GA120NIF----S

5.3. Support

Code	Description
N	Fixed support
C	Circular support 4P Lemo
D	Circular support 1P Lemo

Code example: BA120DAF-----

5.4. Frequency

Code	Description	Frequency
VF	Ultra frequency	700-2500 KHZ
AF	High frequency	350-700 KHZ
MF	Medium frequency	50-350 KHZ
BF	Low frequency	30-50 KHZ
EF	Extra frequency	10-30 KHZ
IF	Infra frequency	0.2-10 KHZ
-	N/A	-

Code example: GA120N**IF**----S

5.5. Centering device

Code	Description
B	Centering device type crossbow
-	Without centering device

Code example: GA120NIF---**-**S

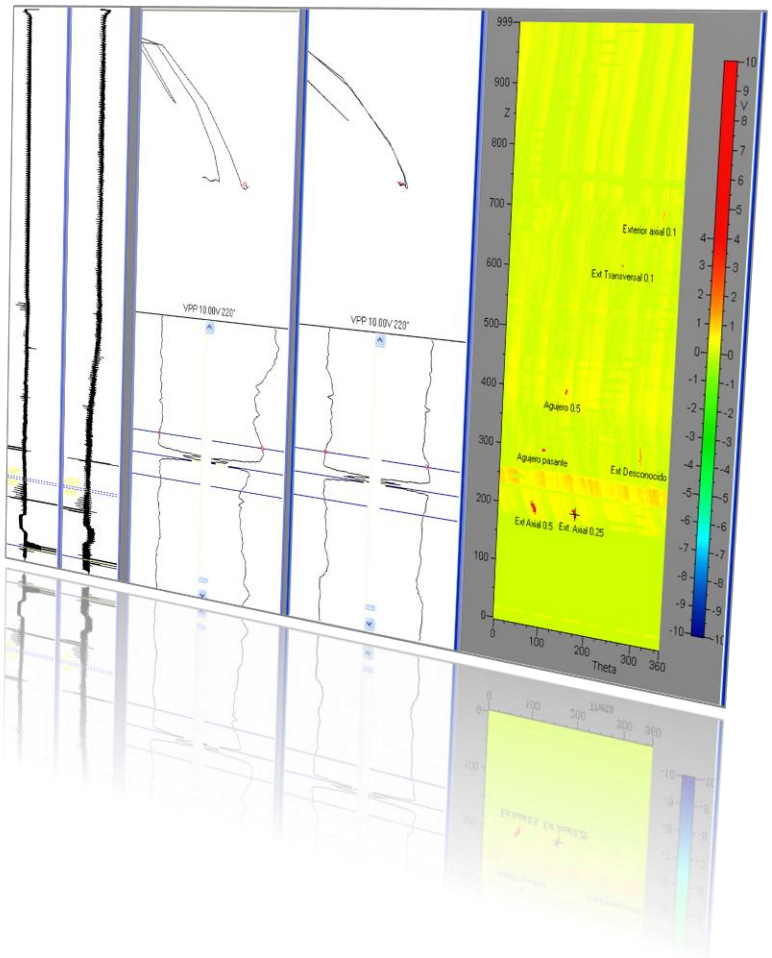
5.6. Magnetic bias

Code	Description
I	Partial magnetic saturation
S	Full magnetic saturation
-	Without magnets

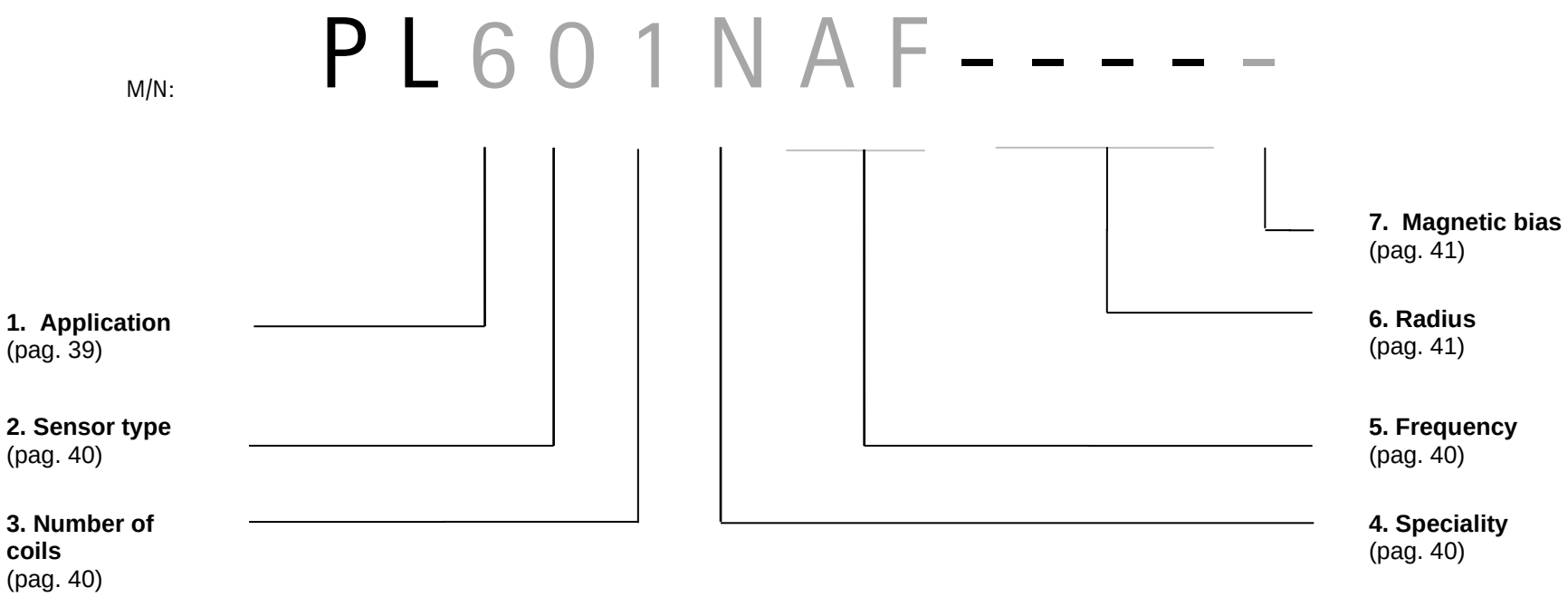
Code example: GA120NIF----**S**

ET surface inspection

When the inspection is a surface, a type of probe with morphology different than previous is necessary. In these cases the product usually is not extended and constant reason why the form of the probe has to be able to adapt perfectly to the surface at issue. These inspections usually is made altogether with some system of generation of coordinates to represent the data in a CSCAN or 3D reason why also usually goes very focused to the manipulator designed for the inspection.
Since the applications of surfaces usually go accompanied of a very concrete specification, they are totally custom-made developed of the client and its application. For more generic and simple cases the generic probes can contribute the most advantageous solution.
Like of any probe of ET, the method of inspection it consists of inducing the currents in the material to inspect thanks to an alternating magnetic field generated by a solenoid excited by an oscillator. Any parameter which can disturb the produced magnetic field by the exciting coil would give as a result a magnetic field changes in the receiving coil and in consequence, a signal variation in the eddy current equipment.



6. ET probe codification for surfaces



Probe examples:
PL5010MF----- = ET probe for the vessel reactor lid (STAR) with cross-coil windings and one element. Common speciality and working at médium frequency .
PL301EAF----- = ET probe for pressure tubes, cross-coil windings and one element. Designed to work at high frequency and by the outside part of the piece.

6.1. Application

APPLICATION	
Code	Description
1	Turbine bore
2	Reactor vessel (CRDs)
3	Fuel rod/ Control rod (Coating measurement)
4	Generic surfaces
5	Vessel lid (STAR)
6	Food bowl
7	Pressure tubes
8	Valve seat

Code example: PL601NAF-----

Surface probe for pressure tubes without support

Probe for control rod surface inspection (SICOM)

Surface probe with support

6.2. Sensor type

Sensor type	
Code	Description
0	Cross-coil
1	Pancake 2mm
2	Pancake 3mm
3	Pancake (generic)

Code example: PL60**0**1NAF-----

6.3. Number of coils

Number of coils	
Code	Description
1	1 coil
2	2 coils
3	3 coils
...	...

Code example: PL601**1**NAF-----

6.4. Speciality

Code	Description
0,N	Common
T	Transition
E	Outside
I	Inside
G	GAP

Code example: PL601**N**AF-----

6.5. Frequency

Code	Description	Frequency
VF	Ultra frequency	700-2500 KHZ
AF	High frequency	350-700 KHZ
MF	Medium frequency	50-350 KHZ
BF	Low frequency	30-50 KHZ
EF	Extra frequency	10-30 KHZ
IF	Infra frequency	0.2-10 KHZ
-	N/A	-

Code example: PL601N**AF**-----

6.6. Radius

Code	Description
1000	1000 mm diameter
0500	500 mm diameter
0100	100 mm diameter
----	No radius

Code example: PL601NAF----

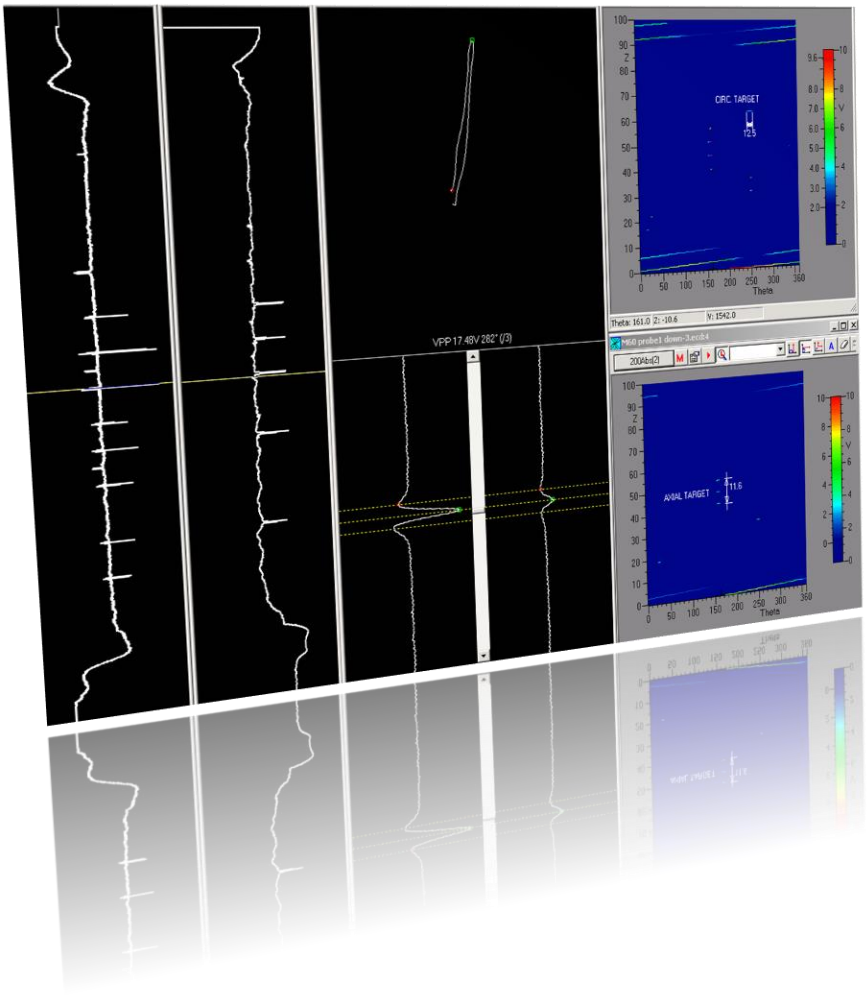
6.7. Magnetic bias

Code	Description
I	Partial magnetic saturation
-	Without magnets

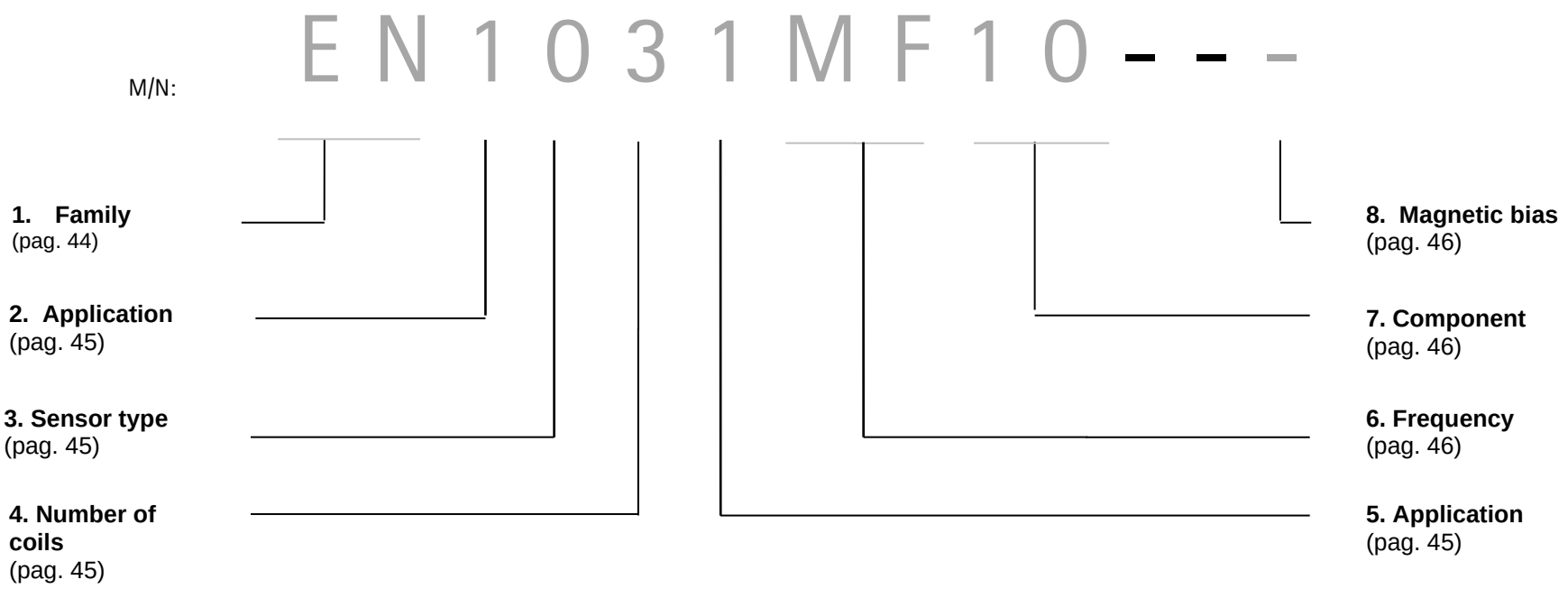
Code example: PL601NAF-----

ET inspection for specific geometry

In these cases, the form of the probe exactly copies the geometry of component to inspect. This type of construction allows to inspect structures or components of very complicated geometry that would be difficult to carry out with any trajectory. Support with its form lodges the winding or windings of inspection that is placed in positions strategic to detect the defects. The inspection is made in total contact helping to the guidance of the movement the form of the probe with the own form of the piece. This type of probes is focused to very complex pieces or with very precise details. The windings of detection of defects can be from a simple element to several ready suitably to make the inspection of passed fast and trustworthy way in an only one.
Like of any probe of ET, the method of inspection it consists of inducing the currents induced in the material to inspect thanks to an alternating magnetic field generated by a solenoid excited by an oscillator. The induced currents analyze the influence of the different parameters in the conductivity from the samples with the phenomenon of the electromagnetic induction.



7. ET probes codification for pieces with specific geometry



Probe examples:
EN103IMF02--- = ET probe with specific geometry for turbines. Cross-coil windings and 3 elements per probe and medium frequency. Designed for tubine type TG-MS-6001B gas and disk 3.

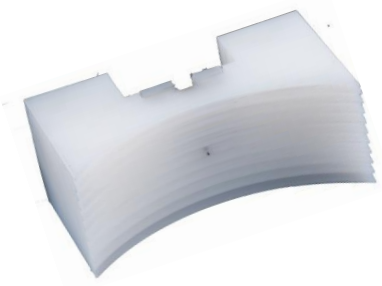
7.1. Family

- The main function of this code is give the type of the probe application:

Code	Description
PE	Cap screw
TU	Nut
EN	Dowel tail

Code example: EN1031MF10---

TU family



PE family

EN family

7.2. Application

APPLICATION	
Code	Description
0	Generic
1	Turbines
2	Reactor vessel

Code example: EN1031MF10---

7.3. Sensor type

COIL TYPE	
Code	Description
0	Cross-coil
1	Pancake 2mm
2	Pancake 3mm

Code example: EN1031MF10---

7.4. Number of coils

Number of coils	
Code	Description
1	1 coil
2	2 coils
3	3 coils
...	...

Code example: EN1031MF10---

7.5. Application

Code	Description
N	Normal
E	Outside area
I	Inside area

Code example: EN1031MF10---

7.6. Frequency

Code	Description	Frequency
VF	Ultra frequency	700-2500 KHZ
AF	High frequency	350-700 KHZ
MF	Medium frequency	50-350 KHZ
BF	Low frequency	30-50 KHZ
EF	Extra frequency	10-30 KHZ
IF	Infra frequency	0.2-10 KHZ

Code example: EN1031MF10----

7.7. Component

Code	Description
00	Turbine TG-MS-6001B steam disk 1 and 2
01	Turbine TG-MS-6001B steam disk 3
02	Turbine TG-MS-6001B gas disk 3
03	Turbine TG-MS-6001B gas disk 1 and 2
04	thread M100x4
--	Not needed to specify

Code example: EN1031MF01---

7.8. Magnetic bias

Code	Description
I	Partial magnetic saturation
-	Without magnets

Code example: EN1031MF10----I

Description of the codification of the serial numbers (informative)

S/N: 0 4 2 2 1 5 0 4

Code	Description
01	January
02	February
03	March
04	April
05	May
06	June
07	July
08	Agoust
09	September
10	October
11	November
12	December

Code	Description
17	Year 2017
18	Year 2018
19	Year 2019
...	...

Code	Description
0001	Unit 1
0002	Unit 2
...	...
9999	Unit 9999

Code example: 03171587

References guide

SN

Catalogue reference	*Probe model*	*Diameter [mm]*	*Frequency*	*Connector*	*Poly*	Nuclear product
0110550025	*SN055NMF10R--*	*5,5*	*50-350 KHZ*	*amphenol 4P*	*10 m*	
0110600026	*SN060NMF10X--*	*6*	*50-350 KHZ*	*amphenol 4P*	*10 m*	
0160680008	*SN068EMF20X--*	*6,8*	*50-350 KHZ*	*amphenol 4P*	*20 m*	
0110680020	*SN068NAF10X--*	*6,8*	*350-700 KHZ*	*amphenol 4P*	*10 m*	
0110800027	*SN080NMF26Y--*	*8*	*50-350 KHZ*	*amphenol 4P*	*26 m*	
0110950013	*SN095NAF26Y--*	*9,5*	*350-700 KHZ*	*amphenol 4P*	*26 m*	
0161000009	*SN100EBF26WB-*	*10*	*30-50 KHZ*	*amphenol 4P*	*26 m*	
0161000003	*SN100EBF26YB-*	*10*	*30-50 KHZ*	*amphenol 4P*	*26 m*	
0111050028	*SN105NBF26W--*	*10,5*	*30-50 KHZ*	*amphenol 4P*	*26 m*	
0111050029	*SN105NMF26Y--*	*10,5*	*50-350 KHZ*	*amphenol 4P*	*26 m*	
0281100006	*SN110EBF26WB-*	*11*	*30-50 KHZ*	*amphenol 4P*	*26 m*	
0161100010	*SN110EBF26YB-*	*11*	*30-50 KHZ*	*amphenol 4P*	*26 m*	
0111150030	*SN115NBF26W--*	*11,5*	*30-50 KHZ*	*amphenol 4P*	*26 m*	
0111150031	*SN115NBF26WB-*	*11,5*	*30-50 KHZ*	*amphenol 4P*	*26 m*	
0281200002	*SN120EMF26WB-*	*12*	*50-350 KHZ*	*amphenol 4P*	*26 m*	
0111200009	*SN120NEF26W--*	*12*	*10-30 KHZ*	*amphenol 4P*	*26 m*	
0161250004	*SN125EAF26WB-*	*12,5*	*350-700 KHZ*	*amphenol 4P*	*26 m*	
0161250011	*SN125EBF26WB-*	*12,5*	*30-50 KHZ*	*amphenol 4P*	*26 m*	
0161250012	*SN125EMF26WB-*	*12,5*	*50-350 KHZ*	*amphenol 4P*	*26 m*	
0281300003	*SN130EAF26WB-*	*13*	*350-700 KHZ*	*amphenol 4P*	*26 m*	
0111300032	*SN130NBF26W--*	*13*	*30-50 KHZ*	*amphenol 4P*	*26 m*	
0111300033	*SN130NMF26W--*	*13*	*50-350 KHZ*	*amphenol 14P*	*26 m*	
0281400005	*SN140EBF26WB-*	*14*	*30-50 KHZ*	*amphenol 4P*	*26 m*	
0111400014	*SN140NBF26W--*	*14*	*30-50 KHZ*	*amphenol 4P*	*26 m*	
0111400010	*SN140NEF26W--*	*14*	*10-30 KHZ*	*amphenol 4P*	*26 m*	
0111450021	*SN145NVF26W--*	*14,5*	*700-2500 KHZ*	*amphenol 4P*	*26 m*	
0111500034	*SN150NBF26W--*	*15*	*30-50 KHZ*	*amphenol 4P*	*26 m*	
0281550001	*SN155EAF26WB-*	*15,5*	*350-700 KHZ*	*amphenol 4P*	*26 m*	
0161650013	*SN165EBF26WB-*	*16,5*	*30-50 KHZ*	*amphenol 4P*	*26 m*	

0161650001	*SN165EMF26WB-*	*16,5*	*50-350 KHZ*	*amphenol 4P*	*26 m*
0111650011	*SN165NVF26W--*	*16,5*	*700-2500 KHZ*	*amphenol 4P*	*26 m*
0111750015	*SN175NVF26W--*	*17,5*	*700-2500 KHZ*	*amphenol 4P*	*26 m*
0301800001	*SN180NMF25W-I*	*18*	*50-350 KHZ*	*amphenol 4P*	*25 m*
0301850002	*SN185NMF25W-I*	*18,5*	*50-350 KHZ*	*amphenol 4P*	*25 m*
0301900003	*SN190NMF25W-I*	*19*	*50-350 KHZ*	*amphenol 4P*	*25 m*
0281950004	*SN195EAF26WB-*	*19,5*	*350-700 KHZ*	*amphenol 4P*	*26 m*
0111950002	*SN195NVF26W--*	*19,5*	*700-2500 KHZ*	*amphenol 4P*	*26 m*
0112000003	*SN200NVF26W--*	*20*	*700-2500 KHZ*	*amphenol 4P*	*26 m*
0112100035	*SN210MEF26W--*	*21*	*10-30 KHZ*	*amphenol 4P*	*26 m*
0112150001	*SN215NVF26W--*	*21,5*	*700-2500 KHZ*	*amphenol 4P*	*26 m*
0112250006	*SN225NVF26W--*	*22,5*	*700-2500 KHZ*	*amphenol 4P*	*26 m*
0112300008	*SN230NBF26W--*	*23*	*30-50 KHZ*	*amphenol 4P*	*26 m*
0112800016	*SN280NMF26W--*	*28*	*50-350 KHZ*	*amphenol 4P*	*26 m*
0112900036	*SN290NBF26W--*	*29*	*30-50 KHZ*	*amphenol 4P*	*26 m*
0112900007	*SN290NVF26W--*	*29*	*700-2500 KHZ*	*amphenol 4P*	*26 m*
0113100037	*SN310NEF26W--*	*31*	*10-30 KHZ*	*amphenol 4P*	*26 m*
0113300012	*SN330NMF26W--*	*33*	*50-350 KHZ*	*amphenol 4P*	*26 m*
0113800022	*SN380NEF26W--*	*38*	*10-30 KHZ*	*amphenol 4P*	*26 m*
0163900007	*SN390EBF26W--*	*39*	*30-50 KHZ*	*amphenol 4P*	*26 m*
0113900023	*SN390NBF26W--*	*39*	*30-50 KHZ*	*amphenol 4P*	*26 m*
0164100005	*SN410EBF20W--*	*41*	*30-50 KHZ*	*amphenol 4P*	*20 m*
0114100017	*SN410NBF26W--*	*41*	*30-50 KHZ*	*amphenol 4P*	*26 m*
0114200038	*SN420NBF26W--*	*42*	*30-50 KHZ*	*amphenol 4P*	*26 m*
0114450018	*SN445NBF26Z--*	*44,5*	*30-50 KHZ*	*amphenol 4P*	*26 m*
0164900002	*SN490EBF26W--*	*49*	*30-50 KHZ*	*amphenol 4P*	*26 m*
0165200006	*SN520EBF26W--*	*52*	*30-50 KHZ*	*amphenol 4P*	*26 m*
0115200024	*SN520NBF26W--*	*52*	*30-50 KHZ*	*amphenol 4P*	*26 m*
0115200019	*SN520NEF26W--*	*52*	*10-30 KHZ*	*amphenol 4P*	*26 m*

SR

Catalogue reference	*Probe model*	*Diameter [mm]*	*Frequency*	*Connector*	*Poly*	Nuclear product
0280900007	*SR090NMF15Y--*	*9*	*50-350 KHZ*	*amphenol 4P*	*15 m*	
0121000015	*SR100NBF26Y--*	*10*	*30-50 KHZ*	*amphenol 4P*	*26 m*	
0121200016	*SR120NBF26W--*	*12*	*30-50 KHZ*	*amphenol 4P*	*26 m*	
0121250024	*SR125NBF26W--*	*12,5*	*30-50 KHZ*	*amphenol 4P*	*26 m*	
0121250017	*SR125NBF26Y--*	*12,5*	*30-50 KHZ*	*amphenol 4P*	*26 m*	
0121250018	*SR125NEF26W--*	*12,5*	*10-30 KHZ*	*amphenol 4P*	*26 m*	
0121300008	*SR130NBF26W--*	*13*	*30-50 KHZ*	*amphenol 4P*	*26 m*	
0121400025	*SR140NBF26W--*	*14*	*30-50 KHZ*	*amphenol 4P*	*26 m*	
0121450026	*SR145NEF26W--*	*14,5*	*10-30 KHZ*	*amphenol 4P*	*26 m*	
0121500002	*SR150NBF26W--*	*15*	*30-50 KHZ*	*amphenol 4P*	*26 m*	
0121500027	*SR150NEF26W--*	*15*	*10-30 KHZ*	*amphenol 4P*	*26 m*	
0121550011	*SR155NAF26W--*	*15,5*	*350-700 KHZ*	*amphenol 4P*	*26 m*	
0121600019	*SR160NEF26W--*	*16*	*10-30 KHZ*	*amphenol 4P*	*26 m*	
0121650005	*SR165NAF26W--*	*16,5*	*350-700 KHZ*	*amphenol 4P*	*26 m*	
0121800009	*SR180NBF26W--*	*18*	*30-50 KHZ*	*amphenol 4P*	*26 m*	
0121800007	*SR180NEF26W--*	*18*	*10-30 KHZ*	*amphenol 4P*	*26 m*	
0121850028	*SR185NBF26W--*	*18,5*	*30-50 KHZ*	*amphenol 4P*	*26 m*	
0121900020	*SR190NBF26W--*	*19*	*30-50 KHZ*	*amphenol 4P*	*26 m*	
0121900029	*SR190NBF26Z--*	*19*	*30-50 KHZ*	*amphenol 4P*	*26 m*	
0121900010	*SR190TVF26W--*	*19*	*700-2500 KHZ*	*amphenol 4P*	*26 m*	
0121950030	*SR195NBF26W--*	*19,5*	*30-50 KHZ*	*amphenol 4P*	*26 m*	
0121950012	*SR195NMF26W--*	*19,5*	*50-350 KHZ*	*amphenol 4P*	*26 m*	
0122000013	*SR200NBF26W--*	*20*	*30-50 KHZ*	*amphenol 4P*	*26 m*	
0122000021	*SR200NEF26W--*	*20*	*10-30 KHZ*	*amphenol 4P*	*26 m*	
0122000031	*SR200NEF26Z--*	*20*	*10-30 KHZ*	*amphenol 4P*	*26 m*	
0122050022	*SR205NAF26W--*	*20,5*	*350-700 KHZ*	*amphenol 4P*	*26 m*	
0122050032	*SR205NAF26Z--*	*20,5*	*350-700 KHZ*	*amphenol 4P*	*26 m*	
0122050001	*SR205NEF26W--*	*20,5*	*10-30 KHZ*	*amphenol 4P*	*26 m*	
0122050014	*SR205NVF26W--*	*20,5*	*700-2500 KHZ*	*amphenol 4P*	*26 m*	
0122100003	*SR210NEF26W--*	*21*	*10-30 KHZ*	*amphenol 4P*	*26 m*	
0122100004	*SR210TVF26W--*	*21*	*700-2500 KHZ*	*amphenol 4P*	*26 m*	
0122150023	*SR215NAF26W--*	*21,5*	*350-700 KHZ*	*amphenol 4P*	*26 m*	
0122200006	*SR220NAF26W--*	*22*	*350-700 KHZ*	*amphenol 4P*	*26 m*	

SP

Catalogue reference	*Probe model*	*Diameter [mm]*	*Frequency*	*Connector*	*Poly*	Nuclear product
0402100001	*SP210NEF26W--*	*21*	*10-30 KHZ*	*amphenol 4P*	*26 m*	

FG

Catalogue reference	*Probe model*	*Diameter [mm]*	*Frequency*	*Connector*	*Poly*	Nuclear product
0150900008	*FG090NMF26YB-*	*9*	*50-350 KHZ*	*amphenol 4P*	*26 m*	●
0151150009	*FG115NMF39WB-*	*11,5*	*50-350 KHZ*	*amphenol 4P*	*39 m*	●
0151200010	*FG120NMF26WB-*	*12*	*50-350 KHZ*	*amphenol 4P*	*26 m*	●
0151220011	*FG122NMF26WB-*	*12,2*	*50-350 KHZ*	*amphenol 4P*	*26 m*	●
0151250013	*FG125NAF26WB-*	*12,5*	*350-700 KHZ*	*amphenol 4P*	*26 m*	●
0151250012	*FG125NMF32WB-*	*12,5*	*50-350 KHZ*	*amphenol 4P*	*32 m*	●
0151300005	*FG130NEF26WB-*	*13*	*10-30 KHZ*	*amphenol 4P*	*26 m*	●
0151300014	*FG130NIF26WB-*	*13*	*0,2-10 KHZ*	*amphenol 4P*	*26 m*	●
0151370015	*FG137NIF26WB-*	*13,7*	*0,2-10 KHZ*	*amphenol 4P*	*26 m*	●
0151400004	*FG140NAF32WB-*	*14*	*350-700 KHZ*	*amphenol 4P*	*32 m*	●
0151400016	*FG140NEF26WB-*	*14*	*10-30 KHZ*	*amphenol 4P*	*26 m*	●
0191430001	*FG143NMF32WBI*	*14,3*	*50-350 KHZ*	*amphenol 4P*	*32 m*	●
0171450001	*FG145MAF32ZB-*	*14,5*	*350-700 KHZ*	*amphenol 4P*	*32 m*	●
0151450017	*FG145NMF32WB-*	*14,5*	*50-350 KHZ*	*amphenol 4P*	*32 m*	●
0151450018	*FG145NMF34WB-*	*14,5*	*50-350 KHZ*	*amphenol 4P*	*34 m*	●
0171450002	*FG145PAF32ZB-*	*14,5*	*350-700 KHZ*	*amphenol 4P*	*32 m*	●
0151470019	*FG147NBF26WB-*	*14,7*	*30-50 KHZ*	*amphenol 4P*	*26 m*	●
0151470020	*FG147NIF26WB-*	*14,7*	*0,2-10 KHZ*	*amphenol 4P*	*26 m*	●
0151500021	*FG150NEF26WB-*	*15*	*10-30 KHZ*	*amphenol 4P*	*26 m*	●
0151500022	*FG150NIF26WB-*	*15*	*0,2-10 KHZ*	*amphenol 4P*	*26 m*	●
0151500006	*FG150NMF32WB-*	*15*	*50-350 KHZ*	*amphenol 4P*	*32 m*	●
0171500003	*FG150PAF32ZB-*	*15*	*350-700 KHZ*	*amphenol 4P*	*32 m*	●
0151550007	*FG155MAF32ZB-*	*15,5*	*350-700 KHZ*	*amphenol 4P*	*32 m*	●

0211550001	*FG155MAF32ZBI*	*15,5*	*350-700 KHZ*	*amphenol 4P*	*32 m*	●
0151550025	*FG155NAF03YB-*	*15,5*	*350-700 KHZ*	*amphenol 4P*	*03 m*	●
0151550026	*FG155NAF32HB-*	*15,5*	*350-700 KHZ*	*amphenol 4P*	*32 m*	●
0151550023	*FG155NAF32PB-*	*15,5*	*350-700 KHZ*	*amphenol 4P*	*32 m*	●
0151550001	*FG155NAF32WB-*	*15.5*	*350-700 KHZ*	*amphenol 4P*	*32 m*	●
0191550002	*FG155NAF32WBI*	*15,5*	*350-700 KHZ*	*amphenol 4P*	*32 m*	●
0151550024	*FG155NAF32YB-*	*15,5*	*350-700 KHZ*	*amphenol 4P*	*32 m*	●
0171750004	*FG175MAF32ZB-*	*17,5*	*350-700 KHZ*	*amphenol 4P*	*32 m*	●
0191750004	*FG175NMF34WBI*	*17,5*	*50-350 KHZ*	*amphenol 4P*	*34 m*	●
0171750005	*FG175PMF32ZB-*	*17,5*	*50-350 KHZ*	*amphenol 4P*	*32 m*	●
0191800005	*FG180NMF34WBI*	*18*	*50-350 KHZ*	*amphenol 4P*	*34 m*	●
0191850003	*FG185NMF32WBI*	*18,5*	*50-350 KHZ*	*amphenol 4P*	*32 m*	●
0191850006	*FG185NMF34WBI*	*18,5*	*50-350 KHZ*	*amphenol 4P*	*34 m*	●

FE

Catalogue reference	*Probe model*	*Diameter [mm]*	*Frequency*	*Connector*	*Poly*	Nuclear product
0251100002	*FE110TBF26YB-*	*11*	*30-50 KHZ*	*amphenol 4P*	*26 m*	●
0251100003	*FE110VBF26YB-*	*11*	*30-50 KHZ*	*amphenol 4P*	*26 m*	●
0251100001	*FE110VMF16CB-*	*11*	*50-350 KHZ*	*amphenol 4P*	*16 m*	●
0251100004	*FE110VMF26YB-*	*11*	*50-350 KHZ*	*amphenol 4P*	*26 m*	●
0251150005	*FE115VMF16CB-*	*11,5*	*50-350 KHZ*	*amphenol 4P*	*16 m*	●
0251500006	*FE150VMF18CB-*	*15*	*50-350 KHZ*	*amphenol 4P*	*18 m*	●

F2

Catalogue reference	*Probe model*	*Diameter [mm]*	*Frequency*	*Connector*	*Poly*	Nuclear product
0541370001	*F2137NMF32QB-*	*13,7*	*50-350 KHZ*	*amphenol 4P*	*32 m*	●
0541500002	*F2150FAF32QB-*	*15*	*350-700 KHZ*	*amphenol 4P*	*32 m*	●
0541500003	*F2150FAF32XB-*	*15*	*350-700 KHZ*	*amphenol 4P*	*32 m*	●

SC

Catalogue reference	*Probe model*	*Diameter [mm]*	*Frequency*	*Connector*	*Poly*	Nuclear product
0620850001	*SC085FBF26YBS*	*8,5*	*30-50 KHZ*	*amphenol 4P*	*26 m*	●
0620900002	*SC090FBF26YBS*	*9*	*30-50 KHZ*	*amphenol 4P*	*26 m*	●

CF

Catalogue reference	*Probe model*	*Diameter [mm]*	*Frequency*	*Connector*	*Poly*	Nuclear product
0331100006	*CF110NMF39WB-*	*11*	*50-350 KHZ*	*amphenol 4P*	*39 m*	●
0331150007	*CF115NMF03YB-*	*11,5*	*50-350 KHZ*	*amphenol 4P*	*03 m*	●
0341150007	*CF115NMF26WB-*	*11,5*	*50-350 KHZ*	*amphenol 4P*	*26 m*	●
0341200010	*CF120PMF32WB-*	*12*	*50-350 KHZ*	*amphenol 4P*	*32 m*	●
0341320008	*CF132PMF32WB-*	*13,2*	*50-350 KHZ*	*amphenol 4P*	*32 m*	●
0341330004	*CF133PMF32WB-*	*13,3*	*50-350 KHZ*	*amphenol 4P*	*32 m*	●
0331370004	*CF137NMF32WB-*	*13,7*	*50-350 KHZ*	*amphenol 4P*	*32 m*	●
0341370011	*CF137PMF32WB-*	*13,7*	*50-350 KHZ*	*amphenol 4P*	*32 m*	●
0341380003	*CF138PMF32WB-*	*13,8*	*50-350 KHZ*	*amphenol 4P*	*32 m*	●
0331430008	*CF143NMF32WB-*	*14,3*	*50-350 KHZ*	*amphenol 4P*	*32 m*	●
0351430001	*CF143NMF32WBI*	*14,3*	*50-350 KHZ*	*amphenol 4P*	*32 m*	●
0341450005	*CF145PAF32WB-*	*14,5*	*350-700 KHZ*	*amphenol 4P*	*32 m*	●
0361450001	*CF145PAF32WBI*	*14,5*	*350-700 KHZ*	*amphenol 4P*	*32 m*	●
0341500009	*CF150MAF32WB-*	*15*	*350-700 KHZ*	*amphenol 4P*	*32 m*	●

0331500001	*CF150NAF32WB-*	*15*	*350-700 KHZ*	*amphenol 4P*	*32 m*	●
0341500012	*CF150PAF32SB-*	*15*	*350-700 KHZ*	*amphenol 4P*	*32 m*	●
0341500002	*CF150PAF32WB-*	*15*	*350-700 KHZ*	*amphenol 4P*	*32 m*	●
0331550009	*CF155NAF32WB-*	*15,5*	*350-700 KHZ*	*amphenol 4P*	*32 m*	●
0331550003	*CF155NMF26ZB-*	*15,5*	*50-350 KHZ*	*amphenol 4P*	*26 m*	●
0341750006	*CF175PMF32WB-*	*17,5*	*50-350 KHZ*	*amphenol 4P*	*32 m*	●
0361750002	*CF175PMF34WBI*	*17,5*	*50-350 KHZ*	*amphenol 4P*	*34 m*	●
0331800002	*CF180NMF32WB-*	*18*	*50-350 KHZ*	*amphenol 4P*	*32 m*	●
0341800001	*CF180PMF32WB-*	*18*	*50-350 KHZ*	*amphenol 4P*	*32 m*	●
0331850005	*CF185NMF32WB-*	*18,5*	*50-350 KHZ*	*amphenol 4P*	*32 m*	●

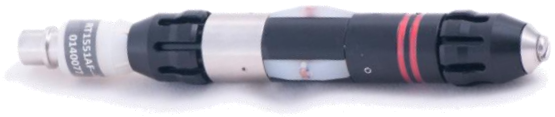
SA

Catalogue reference	*Probe model*	*Diameter [mm]*	*Frequency*	*Connector*	*Poly*	Nuclear product
0531500004	*SA150GAF32YB-*	*15*	*350-700 KHZ*	*amphenol 4P*	*32 m*	●
0531500005	*SA150GAF32ZB-*	*15*	*350-700 KHZ*	*amphenol 4P*	*32 m*	●
0531550001	*SA155GAF32SB-*	*15,5*	*350-700 KHZ*	*amphenol 4P*	*32 m*	●
0531550002	*SA155GAF32YB-*	*15,5*	*350-700 KHZ*	*amphenol 4P*	*32 m*	●
0531800003	*SA180CMF32SB-*	*18*	*50-350 KHZ*	*amphenol 4P*	*32 m*	●

TH

Catalogue reference	*Probe model*	*Diameter [mm]*	*Frequency*	*Connector*	*Poly*	Nuclear product
0260490001	*TH049NMF47A--*	*4,9*	*50-350 KHZ*	*amphenol 4P*	*47 m*	●

RT



Catalogue reference	*Probe model*	*Diameter [mm]*	*Frequency*	*Connector*	*Poly*	Nuclear product
8830900001	*RT0902MF---B-*	*9*	*50-350 KHZ*	*5H/2M*	*N/A*	
0681300001	*RT1302MF05-B-*	*13*	*50-350 KHZ*	*5H/2M*	*05 m*	
0641420002	*RT1420MF---B-*	*14,2*	*50-350 KHZ*	*5H/2M*	*N/A*	●
0641550001	*RT1550AF---B-*	*15,5*	*350-700 KHZ*	*5H/2M*	*N/A*	●
0691550001	*RT1551AF---B-*	*15,5*	*350-700 KHZ*	*5H/2M*	*N/A*	●
0641800003	*RT1800MF---B-*	*18*	*50-350 KHZ*	*5H/2M*	*N/A*	●
0651800001	*RT1800MF---BI*	*18*	*50-350 KHZ*	*5H/2M*	*N/A*	●

PI

Catalogue reference	*Probe model*	*Diameter [mm]*	*Frequency*	*Connector*	*Poly*	Nuclear product
0721400001	*PI1402MF---B-*	*14*	*50-350 KHZ*	*Fischer 4P*	*N/A*	●

MR

Catalogue reference	*Probe model*	*Diameter [mm]*	*Frequency*	*Connector*	*Poly*	Nuclear product
0661550001	*MR155N--20Z--*	*15,5*	*N/A*	*amphenol 10P*	*20 m*	●
0661550002	*MR155N--25Z--*	*15,5*	*N/A*	*amphenol 10P*	*25 m*	●

RC

Catalogue reference	*Probe model*	*Diameter [mm]*	*Frequency*	*Connector*	*Poly*	Nuclear product
0481200001	*RC120VEF02---*	*12*	*10-30 KHZ*	*Lemo 10P*	*02 m*	●

PA

Catalogue reference	*Probe model*	*Diameter [mm]*	*Frequency*	*Connector*	*Poly*	Nuclear product
0500850005	*PA0856MF-----*	*8,5*	*50-350 KHZ*	*amphenol 10P*	*N/A*	
0501300002	*PA1305MF-----*	*13*	*50-350 KHZ*	*amphenol 10P*	*N/A*	
0501450006	*PA1458MF-----*	*14,5*	*50-350 KHZ*	*amphenol 10P*	*N/A*	
0501450007	*PA1458MF10ZB-*	*14,5*	*50-350 KHZ*	*amphenol 10P*	*10 m*	
0501550001	*PA1556MF-----*	*15,5*	*50-350 KHZ*	*amphenol 10P*	*N/A*	
0501850003	*PA1858MF-----*	*18,5*	*50-350 KHZ*	*amphenol 10P*	*N/A*	
0502200004	*PA2208MF-----*	*22*	*50-350 KHZ*	*amphenol 10P*	*N/A*	

PR

Catalogue reference	*Probe model*	*Diameter [mm]*	*Frequency*	*Connector*	*Poly*	Nuclear product
0560900002	*PR0906MC15YB-*	*9*	*50-350 KHZ*	*amphenol 10P*	*15 m*	●
0561550001	*PR1558MC10ZB-*	*15,5*	*50-350 KHZ*	*amphenol 10P*	*10 m*	●
0561550003	*PR1558MF10ZB-*	*15,5*	*50-350 KHZ*	*amphenol 10P*	*10 m*	●

TP

Catalogue reference	*Probe model*	*Diameter [mm]*	*Frequency*	*Connector*	*Poly*	Nuclear product
3161550001	*TP155AAC32ZB-*	*15,5*	*350-700 KHZ*	*amphenol 32P*	*32 m*	●

CL

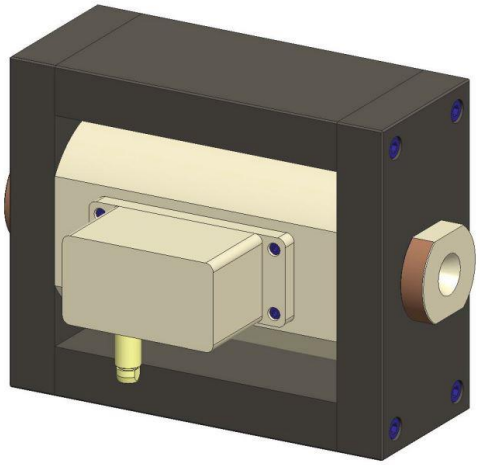
Catalogue reference	*Probe model*	*Diameter [mm]*	*Frequency*	*Connector*	*Poly*	Nuclear product
4320600003	*CL060EBF20R--*	*6*	*20-1000 Hz*	*amphenol 14P*	*20 m*	
4320750001	*CL075EBF20S--*	*7,5*	*20-1000 Hz*	*amphenol 14P*	*20 m*	
0601000004	*CL100PBF20Y--*	*10*	*20-1000 Hz*	*amphenol 14P*	*20 m*	
0601050010	*CL105RBF15Z--*	*10,5*	*20-1000 Hz*	*amphenol 14P*	*15 m*	
0611100002	*CL110FBF15Z--*	*11*	*20-1000 Hz*	*amphenol 14P*	*15 m*	
0601100001	*CL110PBF20Z--*	*11*	*20-1000 Hz*	*amphenol 14P*	*20 m*	
0601100011	*CL110RBF20Z--*	*11*	*20-1000 Hz*	*amphenol 14P*	*20 m*	
0611150001	*CL115FMF20ZB-*	*11,5*	*1000-15000 Hz*	*amphenol 14P*	*20 m*	
0601150012	*CL115PMF20Z--*	*11,5*	*1000-15000 Hz*	*amphenol 14P*	*20 m*	
0601200002	*CL120RBF15Z--*	*12*	*20-1000 Hz*	*amphenol 14P*	*15 m*	
0601250013	*CL125PBF20Z--*	*12,5*	*20-1000 Hz*	*amphenol 14P*	*20 m*	
0601250014	*CL125RBF20Z--*	*12,5*	*20-1000 Hz*	*amphenol 14P*	*20 m*	
0611300003	*CL130FBF20ZB-*	*13*	*20-1000 Hz*	*amphenol 14P*	*20 m*	
0601300005	*CL130NBF20Z--*	*13*	*20-1000 Hz*	*amphenol 14P*	*20 m*	
0601300006	*CL130NMF20Z--*	*13*	*1000-15000 Hz*	*amphenol 14P*	*20 m*	
0601300015	*CL130PBF18Z--*	*13*	*20-1000 Hz*	*amphenol 14P*	*18 m*	
0601300016	*CL130PBF20Z--*	*13*	*20-1000 Hz*	*amphenol 14P*	*20 m*	
0611450004	*CL145FBF20Z--*	*14,5*	*20-1000 Hz*	*amphenol 14P*	*20 m*	
0611450005	*CL145FBF20ZB-*	*14,5*	*20-1000 Hz*	*amphenol 14P*	*20 m*	
0601450003	*CL145PBF20Z--*	*14,5*	*20-1000 Hz*	*amphenol 14P*	*20 m*	
0601450017	*CL145PMF20Z--*	*14,5*	*1000-15000 Hz*	*amphenol 14P*	*20 m*	
0601700007	*CL170RBF20Z--*	*17*	*20-1000 Hz*	*amphenol 14P*	*20 m*	
0601800018	*CL180NBF20Z--*	*18*	*20-1000 Hz*	*amphenol 14P*	*20 m*	
0601800019	*CL180PBF20Z--*	*18*	*20-1000 Hz*	*amphenol 14P*	*20 m*	
0601800020	*CL180RBF20Z--*	*18*	*20-1000 Hz*	*amphenol 14P*	*20 m*	
0601900008	*CL190PBF20Z--*	*19*	*20-1000 Hz*	*amphenol 14P*	*20 m*	
0601900021	*CL190RBF20Z--*	*19*	*20-1000 Hz*	*amphenol 14P*	*20 m*	
0602500022	*CL250PBF20Z--*	*25*	*20-1000 Hz*	*amphenol 14P*	*20 m*	
0602900009	*CL290PBF20T--*	*29*	*20-1000 Hz*	*amphenol 14P*	*20 m*	
0602900023	*CL290RBF20Z--*	*29*	*20-1000 Hz*	*amphenol 14P*	*20 m*	
4323900004	*CL390EBF20T--*	*39*	*20-1000 Hz*	*amphenol 14P*	*20 m*	
4324100002	*CL410EBF20T--*	*41*	*20-1000 Hz*	*amphenol 14P*	*20 m*	
0604100024	*CL410RBF20T--*	*41*	*20-1000 Hz*	*amphenol 14P*	*20 m*	

4324850005	*CL485EBF20T--*	*48,5*	*20-1000 Hz*	*amphenol 14P*	*20 m*	
0604850025	*CL485RBF20T--*	*48,5*	*20-1000 Hz*	*amphenol 14P*	*20 m*	
0615000026	*CL500RBF20Y--*	*50*	*20-1000 Hz*	*amphenol 14P*	*20 m*	

BA

Catalogue reference	*Probe model*	*Diameter [mm]*	*Frequency*	*Connector*	*Poly*	Nuclear product
0581000001	*BA100NAF-----*	*10*	*350-700 KHZ*	*Lemo 4P*	*N/A*	
0591070003	*BA107CAF-----*	*10,7*	*350-700 KHZ*	*Lemo 4P*	*N/A*	●
0591320004	*BA132CAF02---*	*13,2*	*350-700 KHZ*	*Lemo 4P*	*02 m*	

GA



Catalogue reference	*Probe model*	*Diameter [mm]*	*Frequency*	*Connector*	*Poly*	Nuclear product
0741200001	*GA120NIF-----*	*12*	*0,2-10 KHZ*	*Lemo 10P*	*N/A*	●
0751200001	*GA120NIF----S*	*12*	*0,2-10 KHZ*	*Lemo 10P*	*N/A*	●
0741600002	*GA160NIF----S*	*16*	*0,2-10 KHZ*	*Lemo 10P*	*N/A*	●

PL

(see page 37 to see more information)

Catalogue reference	*Probe model*	*Diameter [mm]*	*Frequency*	*Connector*	*Poly*	Nuclear product
0671310001	*PL131IMF310-*	*N/A*	*0,2-10 KHZ*	*2x Lemo 1P*	*N/A*	
0671310002	*PL131IMF440-*	*N/A*	*0,2-10 KHZ*	*2x Lemo 1P*	*N/A*	
0671310003	*PL131IMF620-*	*N/A*	*0,2-10 KHZ*	*2x Lemo 1P*	*N/A*	
0557010007	*PL701IAF104-*	*N/A*	*0,2-10 KHZ*	*2x microdot 1P*	*N/A*	●
0557010008	*PL701EAF112-*	*N/A*	*10-30 KHZ*	*2x microdot 1P*	*N/A*	●
0555010010	*PL5010MF-----*	*N/A*	*50-350 KHZ*	*LEMO 4P*	*N/A*	●
5916010001	*PL601IAF0105-*	*N/A*	*350-700 KHZ*	*2x Lemo 1P*	*N/A*	
0573310002	*PL331NIF-----*	*33,1*	*0,2-10 KHZ*	*LEMO 4P*	*N/A*	●
0573310001	*PL331NVF-----*	*33,1*	*700-2500 KHZ*	*LEMO 4P*	*N/A*	●

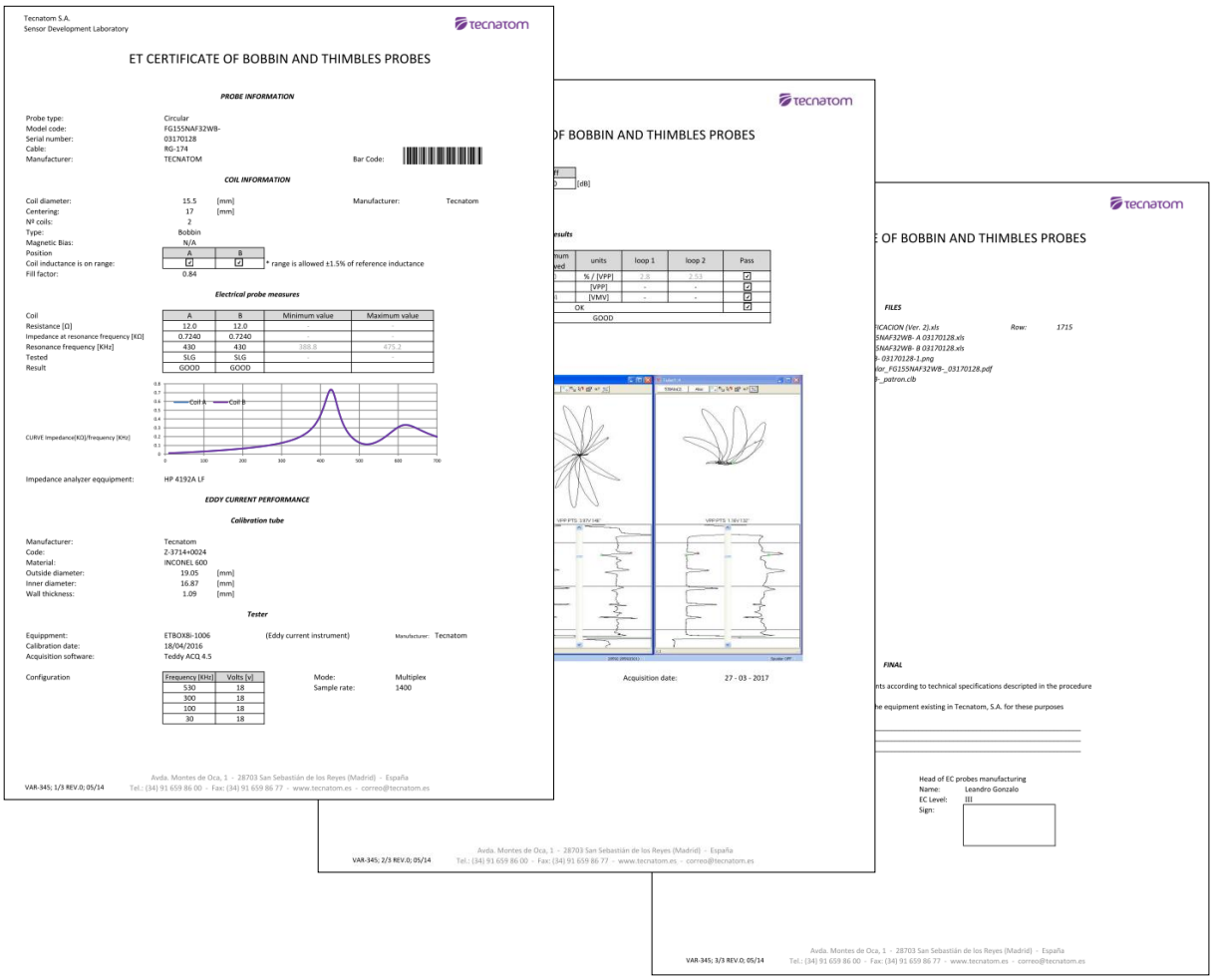
- *The following references had recently changed to an equivalent code:*
  - *SI030NVF30--- (SICOM). (probes for the measure of corrosion coating in control rods)* ➔ *PL331NVF-----*
  - *SI030NIF30--- (SICOM). (probes for the measure of corrosion coating in control rods)* ➔ *PL331NIF-----*
  - *PE104IAF----- (Probe to inspect the inside surface of pressure tubes)* ➔ *PL701IAF104-*
  - *PE112EAF----- (Probe to inspect the outside surface of pressure tubes)* ➔ *PL701EAF112-*

EN

Catalogue reference	*Probe model*	*Diameter [mm]*	*Frequency*	*Connector*	*Poly*	Nuclear product
0631030001	*EN103IMF01-*	*N/A*	*50-350 KHZ*	*Lemo 7 pin*	*N/A*	
0631040002	*EN104IMF01-*	*N/A*	*50-350 KHZ*	*Lemo 7 pin*	*N/A*	

Certificates

The probes are proven following the existing procedures of manufacture for each model and type of probe. Those of nuclear sector in addition they are accompanied by a certificate that assures the fulfilment criteria of design for this type of surroundings. The reflected levels of signal in certificates guarantee to be agreed with the demanded specifications even detailing the conditions of measurement. In addition, measurements of the most important parameters are contributed, a report of the probe in a laboratory inspection and the companies of the personnel implied in the accomplishment of the certificate


Tecnatom S.A.
Sensor Development Laboratory

ET CERTIFICATE OF BOBBIN AND THIMBLES PROBES

PROBE INFORMATION

Probe type: Circular
Model code: FG155NAF32WB-
Serial number: 03170128
Cable: RG-174
Manufacturer: TECNATOM
Bar Code:

COIL INFORMATION

Coil diameter: 15.5 [mm]
Centering: 17 [mm]
Nº coils: 2
Type: Bobbin
Magnetic Bias: N/A
Position: A ☑ B ☑
Coil inductance is on range: * range is allowed ±1.5% of reference inductance
Fill factor: 0.84
Manufacturer: Tecnatom

Electrical probe measures

Coil	A	B	Minimum value	Maximum value
Resistance [Ω]	12.0	12.0	-	-
Impedance at resonance frequency [KΩ]	0.7240	0.7240	-	-
Resonance frequency [KHz]	430	430	388.8	475.2
Tested	SLG	SLG	-	-
Result	GOOD	GOOD		

CURVE Impedance(KΩ)/Frequency [KHz]

Impedance analyzer eqquipment: HP 4192A LF

EDDY CURRENT PERFORMANCE

Calibration tube

Manufacturer: Tecnatom
Code: Z-3714+0024
Material: INCONEL 600
Outside diameter: 19.05 [mm]
Inner diameter: 16.87 [mm]
Wall thickness: 1.09 [mm]

Tester

Equipment: ETBOX8i-1006 (Eddy current instrument) Manufacturer: Tecnatom
Calibration date: 18/04/2016
Acquisition software: Teddy ACQ 4.5

Configuration

Frequency [KHz]	Volts [v]
530	18
300	18
100	18
30	18

Mode: Multiplex
Sample rate: 1400

Avda. Montes de Oca, 1 - 28703 San Sebastián de los Reyes (Madrid) - España
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VAR-345; 1/3 REV.0; 05/14

OF BOBBIN AND THIMBLES PROBES

	units	loop 1	loop 2	Pass
	% / [VPP]	2.8	2.53	☑
	[VPP]	-	-	☑
	[VMV]	-	-	☑
OK				☑
GOOD				

Acquisition date: 27 - 03 - 2017

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VAR-345; 2/3 REV.0; 05/14

OF BOBBIN AND THIMBLES PROBES

FILES

Row: 1715

FINAL

Head of EC probes manufacturing
Name: Leandro Gonzalo
EC Level: III
Sign:

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VAR-345; 3/3 REV.0; 05/14

Adapters

Most probes are connected to the equipment by adapters. They are shown in the next table. Probes or families not referenced can be connected directly to the equipment there or they uses and specific adapter. Contact to choose the proper adapter to these cases.

Adapter	Family or probe	Equippment	Remarks
E2iBB42BDI	SN, SR, SP, FG, FE, F2, SC, CF, SA, TH	ETbox2i	Adapter to 2 probes in differential mode
E2iBB41BDA	SN, SR, SP, FG, FE, F2, SC, CF, SA, TH	ETbox2i	Adapter to 1 probe in differential-absolute mode
E2iBB41BDS	SN, SR, SP, FG, FE, F2, SC, CF, SA, TH	ETbox2i	Adapter to 1 probe differential-absolute with simulated reference coil
ET8BB41BDA	SN, SR, SP, FG, FE, F2, SC, CF, SA, TH	ETbox8i	Adapter to 1 probe in differential-absolute mode
ET8BB42BDA	SN, SR, SP, FG, FE, F2, SC, CF, SA, TH	ETbox8i	Adapter to 2 probes in differential-absolute mode
ET8BB44BDA	SN, SR, SP, FG, FE, F2, SC, CF, SA, TH	ETbox8i	Adapter to 4 probes in differential-absolute mode
E2iRFA1RFT	CL	ETbox2i	Adapter to 1 RFT probe
ET8RFA1RFT	CL	ETbox8i	Adapter to 1 RFT probe
ET8MRP1RPC	MR	ETbox8i	Adapter to 1 rotating probe motor
ET8MRP2RPC	MR	ETbox8i	Adapter to 2 rotating probes motors
E2iSCS2SC	PL331NVF-----	ETbox2i	Adapter to corrosion probes SICOM
E8iSPM81BS	PR1558MC10ZB-	ETbox8i	Adapter to array 8x1 + bobbin probe profilometry
E8i61B81TR	PR0906MC15YB-	ETbox8i	Adapter to 6x1 array + bobbin
E8iTP31TPD	TP155AAC32ZB-	ETbox8i	Tprobe array adapter
E2iTP31TPD	TP155AAC32ZB-	ETbox2i	Tprobe array adapter
EPPTP31TPD	TP155AAC32ZB-	ETboxPPD	Tprobe array adapter
E2iGADS1PC	GA	ETbox2i	Adapter to gadolinium probes
E2iGADS1PC	PL	ETbox2i	Adapter to PL probes and Lemo connector

ETbox8i
Eddy Current Instrument

An Advanced Eddy Current Instrument

ETbox8i is a digital multi-channel and multi-frequency eddy current instrument for inspection of components in the electricity generation, nuclear and industrial sectors. It supports standard eddy current (ET) and remote field (RFT) tubing probes and surface scanning arrays. TEDDY software available for acquisition and analysis

ETbox8i

Etbox2i is the portable version of the Etbox8i keeping same features than his big brother up to 128 channels.

ETbox2i

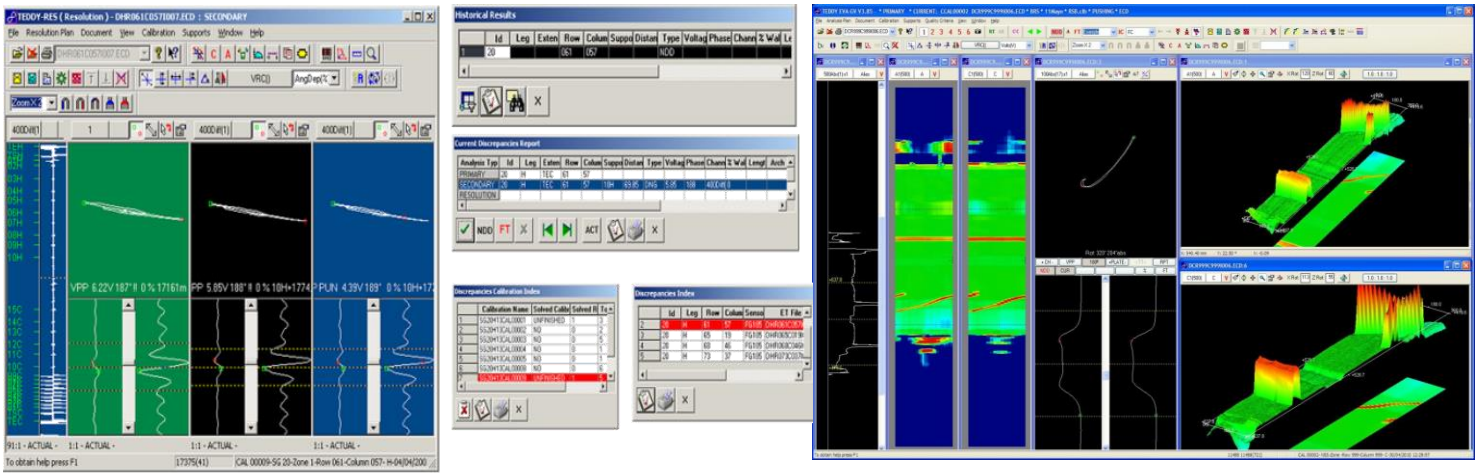
ETbox8i. Main Features

- Multi-channel and multi-frequency capabilities. Up to 512 channels.
- Configurable with different probes: Bobbin, MRPC, Multi-coil and Array for tubing inspection and surfaces inspection based on Multi-coil or Array probes. Multiplexer options.
- Multiplexed and simultaneous injection modes.
- Wide frequency range of 10 Hz to 5 MHz. Independent channel gain control. Hardware null and reference probe simulation.
- 100% digital signal processing on board. FIR filters and signal detection threshold.
- No ventilation fans needed, low power consumption.
- High immunity against EMC noises. Single board. No wires.
- On board 100/1000 Ethernet FPGA controller. No need of embedded PCs.
- Easy to transport. Reduced Weight.
- Full compatible with TEDDY software running under Windows. Advanced acquisition and analysis software for tubing inspection and surfaces.
- Data display in real time: Strip-chart, Lissajous, C-Scan, and 3D views.
- User definable screens.
- Configuration and calibration of instrument. Digital filters.
- Integration with mechanical systems.

TeddyEVA. SG And HE Analysis

Eddy Current Software Analysis for Tubing Inspection

TeddyEVA (SG/HE) is an application specializing in manual or automatic analysis of massive data from tube bundle inspections as Steam Generators, Condensers, Heat Exchangers and related components. It has been developed especially to achieve fast, efficient and reliable analysis of large volumes of data.



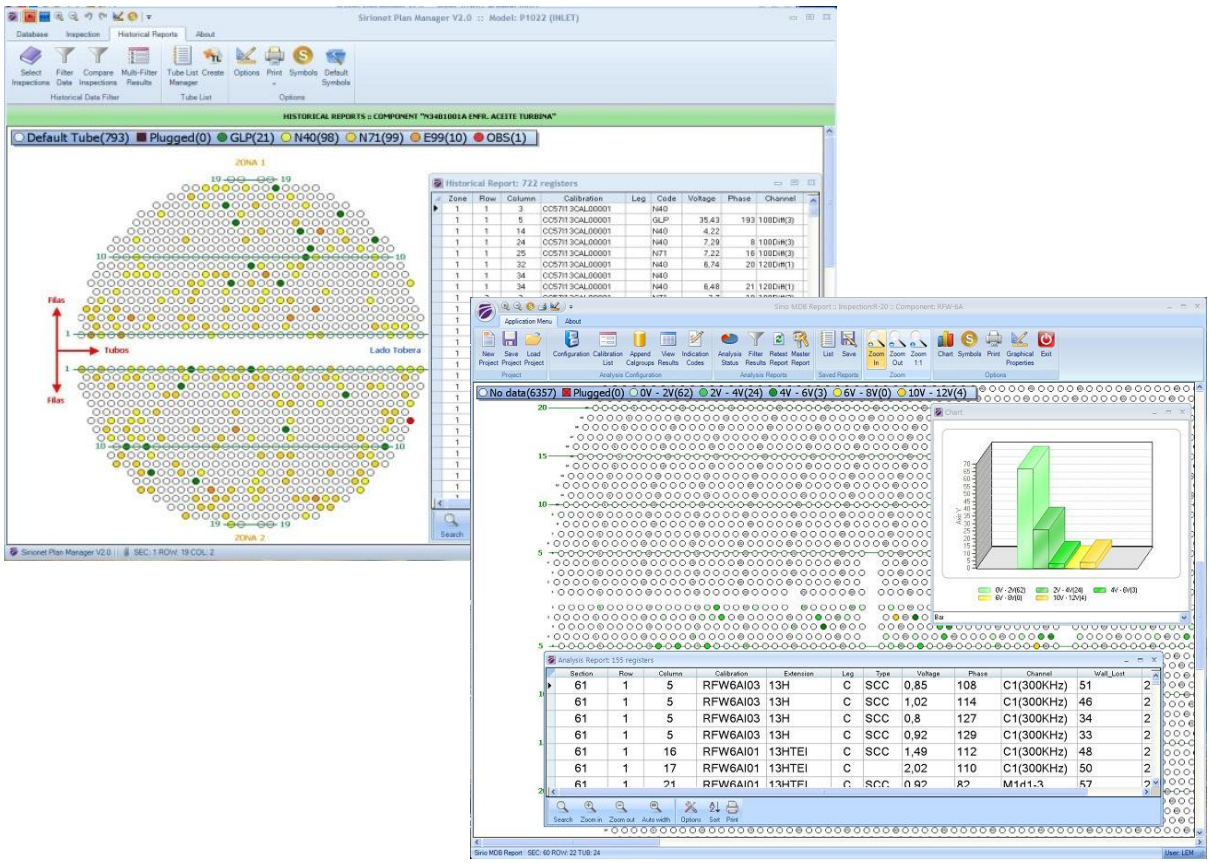
TeddyEVA. Main Features

- Multiple EC data displays (Stripchart, Lissajous, C-Scan, 3D-View, C-Scanchart) configurable by the user.
- Simultaneous views of signals from different tubes
- Bobbin coil, MRPC, MultiCoil, and Array analysis
- Sizing and editing tools
- Automatic crack mapping
- Different 3D displays options: mesh mode, solid, volts calibration color, C-Scan projection and geometric view of part inspected.
- Connection with historic records
- Signal processing and digital filtering tools
- Calibration axial axis by means of marks, pulses, or encoders
- Automatic detection of SG structures (including VVER models)
- Automatic calibration and mixing, duplicated and filtered channels.
- Automatic signal analysis
- Reading file data formats Miz-18 and Miz-30
- Verification of data quality
- Definition of types of indications for automatic reporting
- Profilometry (radius and diameters) with Bobbin, Multicoil and Array probes
- Z-Scan and cylindrical 3D type display

SirioNet

Data Management Tubing Inspection Software

SirioNET is a set of specialized applications to build tube sheet maps, inspection plans, data coordination and manage analysis results of data from tube bundle inspections as steam generators, condensers, heat exchangers and related components. It supported on SQL server database or local MDB files. It developed to achieve fast, efficient and reliable manage of large volumes of data, synchronizing groups of operators and analysts.



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