



TECHNICAL SELECTION GUIDE

Metal & X-Ray Detectable Compounds

Material selection, compound range, detectability, compliance and application guidance for hygienic and industrial sealing.

Purpose of this guide

- Understand how metal- and X-ray-detectable compounds work.
- Compare the current NBR, FKM, EPDM and silicone detectable ranges.
- Select the right elastomer family for the process and inspection technology.
- Plan validation, compliance and RFQ documentation.

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1 TECHNICAL FUNDAMENTALS

How detectable compounds work

Detectability is an additional contamination-control feature — not a substitute for correct seal design, hygiene or line validation.

Conventional elastomers can be difficult for production-line inspection systems to distinguish from the surrounding product. Detectable formulations incorporate specialist additives intended to increase the response of the elastomer to metal detection, X-ray inspection, or both, depending on the compound design.

Metal detection

A detectable additive package increases the electromagnetic response of a seal fragment so that an industrial metal detector has a better chance of identifying it as foreign material.

X-ray inspection

X-ray systems identify density or attenuation differences. X-ray detectable formulations are engineered to create greater contrast than conventional rubber in suitable inspection conditions.

Visual identification

Blue is widely used for process seals because it provides strong visual contrast against many food products. Black detectable grades are also available for applications where colour is less important.

Detection is system-dependent

A compound cannot have one universal guaranteed fragment size. Aperture, product effect, line speed, fragment orientation, equipment settings and the product itself all influence sensitivity.

What changes when a compound becomes detectable?

The elastomer family still determines most of the sealing behaviour — chemical resistance, thermal capability, compression behaviour and mechanical durability. The detectable filler system adds the inspection response, but it can also influence physical properties. For that reason, a detectable grade should be treated as its own engineered compound rather than assumed to perform identically to a standard non-detectable rubber.

Critical validation principle

Representative seal fragments should be tested through the customer's actual inspection equipment using the real product, pack format and production settings. Published detectability data is useful for comparison, but line validation remains essential.

Key factors that influence detection performance

- Compound formulation and detectable additive loading.
- Fragment mass, geometry, thickness and orientation.
- Metal detector aperture size, frequency, sensitivity and product effect.
- X-ray energy, detector resolution, product density, pack depth and overlapping features.
- Line speed, packaging material and the position of the fragment within the product.

2 AVAILABLE RANGE

Detectable compound range

Current standard references available through International Seal. Custom compounds and alternative colours may be available for project requirements.

Code	Polymer	Hardness	Colour	Positioning
CD100	NBR	70 Shore A	Black	Detectable NBR for general oil-resistant sealing
CD102	NBR	70 Shore A	Blue	Blue detectable NBR for hygienic / process visibility
CD200	FKM	75 Shore A	Black	Higher-temperature, oil and chemical resistant detectable FKM
CD201	FKM	75 Shore A	Blue	Blue detectable FKM for demanding process applications
CD300	EPDM	70 Shore A	Black	Detectable EPDM for water, steam and many CIP environments
CD301	EPDM	70 Shore A	Blue	Blue detectable EPDM for hygienic service
CD401	Silicone	70 Shore A	Blue	Detectable silicone for flexible, hygienic sealing applications

Current manufacturer compliance statement

Current manufacturing-partner literature identifies the detectable range as available to FDA CFR 21 Section 177.2600 requirements. Compliance is formulation-specific. Always request the current declaration for the exact compound and production batch before specification or audit use.

2 AVAILABLE RANGE (CONTINUED)

Range options

Standard colours

Blue and black are the principal standard colour options in the current range. Other colours may be possible subject to formulation and volume.

Custom compounding

Application-specific hardness, colour, material family or detectability targets may be possible where commercial quantities justify a custom formulation.

Product formats

O-rings, hygienic gaskets, X-rings, square rings and custom moulded components can be considered, subject to tooling, size and material availability.

Documentation

Technical data sheets, material declarations, inspection data and certificates should be matched to the exact grade. Request document requirements at RFQ stage.

Important code note

The CD codes in this guide are reference compound identifiers for the current detectable range. They should not be treated as a complete material specification on their own. Purchase documentation should also state the seal profile, dimensions, required compliance, inspection technology and any process-specific conditions.

3 COMPOUNDS AVAILABLE

Contaminant detectable compounds — full code reference

The complete current range of contaminant detectable compound codes across all four polymer families, for use alongside the family-specific technical data on the following pages.

NBR — Contaminant Detectable		70 DURO
Code	Colour	
CD100	Black	
CD101	Red	
CD102	Blue	
CD103	White	
CD104	Yellow	
CD105	Green	
CD106	Purple	

EPDM — Contaminant Detectable		75 DURO
Code	Colour	
CD300	Black	
CD301	Blue	

FKM — Contaminant Detectable		75 DURO
Code	Colour	
CD200	Black	
CD201	Blue	
CD202	Red	
CD203	Green	
CD204	Purple	

Silicone — Contaminant Detectable		75 DURO
Code	Colour	
CD400	Red	
CD401	Blue	

Using this reference

Confirm the polymer family against the process media and temperature (see the family pages that follow), then select colour and code from the table above. As with the wider range, these codes are compound identifiers and should be accompanied by full seal-profile, dimensional and compliance documentation at order stage.

4 NBR DETECTABLE COMPOUNDS

Nitrile — 70 Shore A detectable grades

Detectable NBR is a practical option where the sealing environment includes oils, greases and many hydrocarbon-based lubricants. It is commonly chosen for general process equipment where good mechanical properties and cost control are important.

CD100

NBR 70 Black

CD102

NBR 70 Blue

Typical strengths

Good resistance to many mineral oils and greases. Good general mechanical strength and abrasion resistance. Widely used, familiar sealing polymer for industrial applications. Available in blue and black detectable grades.

Selection cautions

Not normally the first choice for sustained hot water or steam. Poorer ozone and weathering resistance than EPDM. Compatibility with aromatic fuels, aggressive solvents and additives is grade-dependent. High-temperature capability is lower than FKM in many applications.

Typical application fit

- Oil-handling pumps and process equipment.
- General machinery where leakage and foreign-body control are both concerns.
- Food-processing equipment where a nitrile-compatible process medium is present.
- Custom moulded components, O-rings and non-steam hygienic duties when the grade is otherwise suitable.

Compatibility snapshot — family guidance only

Mineral oils / greases	Strong
Water	Moderate
Hot water / steam	Limited – verify
Dilute acids / alkalis	Moderate – grade dependent
Ozone / outdoor exposure	Limited

Selection note

Choose NBR when oil resistance and general-purpose mechanical performance are the primary drivers. If the process is dominated by steam, hot water or aggressive CIP chemistry, compare EPDM and FKM before finalising the material.

5 EPDM DETECTABLE COMPOUNDS

EPDM — 70 Shore A detectable grades

Detectable EPDM is particularly relevant to hygienic processing because EPDM is widely used with water-based media, hot water, steam and many cleaning solutions. It is often a strong starting point for food and beverage gasket applications where oils or fuels are not the main exposure.

CD300

EPDM 70 Black

CD301

EPDM 70 Blue

Typical strengths

Very good water and weathering resistance. Good performance with many dilute acids, alkalis and polar media. Common choice for hygienic seals and cleaning-intensive equipment. Good ozone and ageing resistance.

Selection cautions

Poor compatibility with mineral oils, fuels and many hydrocarbons. Actual steam and CIP limits depend strongly on temperature, concentration and formulation. Certain concentrated chemicals can cause swelling or degradation. Do not assume a standard EPDM chemical chart automatically applies to every detectable grade.

Typical application fit

- RJT, DIN 11851, SMS and Tri-Clamp gasket applications where EPDM is compatible.
- Beverage, dairy and water-based process lines.
- CIP-cleaned equipment and valve / pump seals, subject to cycle validation.
- General hygienic equipment exposed to weathering or ozone.

Compatibility snapshot — family guidance only

Water	Strong
Hot water	Strong – verify temperature
Steam / CIP	Often strong – validate cycle
Dilute acids / alkalis	Strong to moderate
Mineral oils / fuels	Limited

Selection note

EPDM is frequently the preferred detectable elastomer for water-based hygienic processes. The main exclusion is oil and hydrocarbon exposure, where NBR or FKM will usually deserve closer consideration.

6 FKM DETECTABLE COMPOUNDS

Fluoroelastomer — 75 Shore A detectable grades

Detectable FKM is aimed at more demanding sealing duties involving elevated temperature, oils, fuels and a broad range of aggressive process chemicals. It is useful where a standard general-purpose elastomer would not provide enough chemical or thermal margin.

CD200

FKM 75 Black

CD201

FKM 75 Blue

Typical strengths

Excellent resistance to many oils, fuels and hydrocarbons. Higher-temperature capability than NBR in many applications. Low gas permeability compared with many general elastomers. Useful for demanding chemical and process environments.

Selection cautions

Hot water and steam resistance varies by FKM chemistry and service conditions. Strong bases, amines, ketones and certain polar solvents can be problematic for standard FKM families. Generally higher cost than NBR or EPDM. Low-temperature flexibility can be more limited than silicone or specialist low-temperature grades.

Typical application fit

- Oil, lubricant and fuel handling.
- Process equipment with elevated operating temperature.
- Chemical processing duties where FKM compatibility is confirmed.
- Hygienic equipment requiring detectable FKM because of process-media resistance.

Compatibility snapshot — family guidance only

Mineral oils / fuels	Strong
Hydrocarbons	Strong
Water	Moderate – verify
Steam	Grade dependent
Acids	Often strong – verify concentration
Strong bases / amines	Limited / grade dependent

Selection note

FKM should be selected because the process chemistry or temperature requires it — not simply because it is a premium polymer. For steam-heavy or strongly alkaline CIP service, confirm the exact formulation before choosing FKM over EPDM.

7 SILICONE DETECTABLE COMPOUNDS

Silicone — 70 Shore A detectable grade

Detectable silicone combines excellent flexibility over a broad temperature range with the cleanliness and visual properties associated with silicone sealing. It can be valuable in hygienic equipment, low-temperature service and applications where soft, flexible sealing behaviour is important.

CD401

Silicone 70 Blue

Custom

Alternative silicone compounds subject to project requirements

Typical strengths

Excellent low-temperature flexibility. Good dry-heat capability for many formulations. Good ozone and weathering resistance. Clean, visually distinctive material for hygienic components.

Selection cautions

Lower tear and abrasion strength than many NBR or EPDM compounds. Oil and fuel resistance is generally limited compared with FKM or NBR. Steam life and compression behaviour depend heavily on formulation and duty cycle. Not every silicone grade is suitable for high-pressure dynamic sealing.

Typical application fit

- Hygienic seals requiring flexibility and visual identification.
- Low-temperature equipment.
- Static gaskets and O-rings where silicone compatibility is appropriate.
- Custom moulded components used in food, beverage and pharmaceutical equipment.

Compatibility snapshot — family guidance only

Low temperature	Strong
Dry heat	Strong – verify grade limit
Water	Good
Steam	Moderate / grade dependent
Oils / fuels	Limited
Ozone / weather	Strong

Selection note

Silicone is often selected for temperature flexibility and cleanliness rather than wear resistance. Confirm compression set, tear strength and the actual cleaning regime when the seal will be cycled frequently or exposed to mechanical damage.

8 VALIDATION AND COMPLIANCE

Validation, compliance & documentation

A detectable seal should be specified as both a sealing component and a contamination-control component.

Recommended validation sequence

- 1 Define the risk — identify where seal damage could enter exposed product and which inspection technology protects the line.
- 2 Select the base polymer — choose the elastomer family from the process media, temperature, pressure, cleaning cycle and mechanical duty.
- 3 Confirm the detectable grade — match colour, hardness, metal / X-ray response and required regulatory documentation.
- 4 Test representative fragments — use realistic fragment shapes and sizes, not only ideal laboratory test pieces.
- 5 Test on the actual line — run the real product, pack format, line speed and inspection settings through production equipment.
- 6 Record the result — document the validated sensitivity, sample method and inspection settings within the site quality system.

Compliance and audit notes

- FDA 21 CFR 177.2600 status is formulation-specific. Obtain the current declaration for the exact compound being supplied.
- Detectability does not by itself make a seal food-contact compliant. The base formulation, ingredients and manufacturing controls still matter.
- A HACCP plan may identify detectable sealing as a useful control measure, but HACCP does not create one universal requirement for every seal on every line.
- Where EU 1935/2004, USP Class VI, WRAS, 3-A, EC 2023/2006 or another scheme is required, state this during quotation so the exact grade and evidence can be checked.
- Batch traceability, certificates of conformity and material declarations should be agreed as part of the order documentation when they are critical to the customer.

Do not rely on colour alone

Blue improves visual identification but is not proof that a seal is metal detectable, X-ray detectable or food-contact compliant. Specify the exact compound code and required documentation.

9 PRODUCTS AND SPECIFICATION

Seal types & how to specify them

Detectable compounds can be considered across standard and custom sealing formats, subject to tooling, section size and grade availability.

Typical product formats

O-rings

Standard metric and imperial sizes, including AS568 and application-specific dimensions.

Hygienic gaskets

RJT, DIN 11851, SMS, Tri-Clamp and other sanitary profiles subject to size and tooling.

Profile seals

X-rings, square rings and other moulded cross-sections for specialist grooves or equipment designs.

Custom mouldings

Application-specific gaskets, diaphragms, boots, plugs, pads and other rubber components where detectable material adds contamination-control value.

Information to include with an RFQ

Requirement	What to provide
Seal type / drawing	O-ring size, sanitary standard, customer drawing or sample reference.
Dimensions	ID, OD, cross-section, thickness, tolerances and critical features.
Process media	Food product, oils, chemicals, cleaning agents and concentrations.
Temperature	Normal operating range plus cleaning / sterilisation peaks.
Pressure / motion	Static or dynamic duty, pressure, vacuum, speed and cycling frequency.
Inspection system	Metal detector, X-ray, or both; aperture and validated sensitivity where known.
Compliance	FDA / EU / USP / WRAS / customer-specific requirements.
Documentation	TDS, declaration, CoC, batch traceability or test reports required.
Quantity	Prototype / trial quantity and expected production demand.

Prototype and trials

For a new detectable-seal programme, it can be more valuable to start with a representative trial quantity and complete line validation before committing to full production volumes.

10 QUICK SELECTION GUIDE

Preliminary material selector

Use this matrix to narrow the material family, then confirm the exact detectable grade against the application and current technical data sheet.

Application driver	Starting point	Technical note
Oil / grease dominated duty	NBR or FKM	FKM if temperature or chemical severity is higher.
Hot water / many hygienic CIP duties	EPDM	Validate cleaning chemistry, temperature and cycle duration.
Fuel / hydrocarbon exposure	FKM or NBR	FKM generally offers the broader high-temperature margin.
Wide temperature flexibility / low temperature	Silicone	Check tear strength, compression set and process-media compatibility.
Weather / ozone exposure	EPDM or Silicone	Both typically outperform NBR for outdoor ageing.
High-temperature chemical process	FKM	Confirm exact chemical and steam compatibility.
Blue visual identification required	CD102 / CD201 / CD301 / CD401	Select the polymer first; colour is secondary to compatibility.
Black detectable compound required	CD100 / CD200 / CD300	Confirm inspection technology and detectability targets.

10 QUICK SELECTION GUIDE (CONTINUED)

Before placing an order

- Confirm the seal profile and dimensions.
- Confirm the operating and cleaning media.
- Confirm normal and peak temperature.
- State whether metal detection, X-ray inspection or both are required.
- Agree the compliance documents and traceability required.
- Validate representative fragments on the production inspection system.

Technical support

International Seal can help narrow the appropriate detectable compound from the seal geometry, process media, operating temperature, cleaning regime and inspection technology. Send the drawing or seal size together with the application conditions for review.

Technical note: this guide provides general compound-selection and application guidance and does not constitute a performance guarantee, regulatory approval or substitute for a site-specific risk assessment and validation. FDA 21 CFR 177.2600 status and other compliance claims are formulation-specific — always request the current declaration for the exact compound and production batch supplied.

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