CDI ENERGY PRODUCTS®
A Michelin Group Company

Technical Report
API 6A, Appendix-F Immersions

To better serve our customers manufacturing high performance downhole and wellhead equipment for the oil and gas industry, CDI Energy Products has evaluated several CDI elastomeric and thermoplastic seal compounds using the immersion testing procedure specified in **API 6A, Appendix F** (also known as ISO 10423:2009).

The compounds selected are extensively used in sealing solutions provided by CDI Energy Products.

The testing was contracted with independent laboratories, including MERL in the UK, Akron Rubber Development Laboratory Inc. (ARDL) located in Ohio, USA and Alpine Polytech in Texas, USA.

Appendix F1.13.5.2:

This procedure is used to evaluate polymer compounds for service in liquids and gases representative of the intended application environment. The test parameters that can be selected are the composition of the gas/liquid phase and the test temperature. The test media is determined by the appropriate API 6A Material Class. The test temperature used correspond to the API 6A Temperature Classes. However, API allows a bespoke media, temperature, pressure and/or duration to be specified by the end user.

Dog-bone or dumb-bell specimens per ASTM D412 (elastomer) D-638 (thermoplastics) or D-1708 (PTFE) are aged in the liquid phase of the test chamber at the specified temperature at 6.9 MPa (1000 psi) for a standard exposure period of 160 hours. The percent change of the physical properties of the aged and un-aged specimens are reported. Acceptance criteria will be specified by the end user or the seal manufacturer based on the intended application.

Test Temperature	Standard Test Pressure	Standard Duration
Typically the Upper Operating Temperature or Bespoke	6.9 MPa (1000 psi)	160 hours

API 6A Material Class		Gas Phase	Liquid Phase
AA/BB	General Service	5% CO_2 / 95% CH_4	Kerosene + 5% De-ionized H2O
CC	General Service	80% CO_2 / 20% CH_4	
DD/EE	Sour Service	10% H_2S / 5% CO_2 / 85% CH_4	
FF/HH	Sour Service	10% H_2S / 80% CO_2 / 10% CH_4	
Bespoke		As Specified by User	

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API 6A Temperature Classification	Operating Range °F			Operating Range °C		
K	-75	To	+180	+60	To	+82
L	-50	To	+180	-46	To	+82
P	-20	To	+180	-29	To	+82
R	+74	To	+74	+23	To	+23
S	0	To	+150	-18	To	+66
T	0	To	+180	-18	To	+82
U	0	To	+250	-18	To	+121
V	+35	To	+250	+2	To	+121
X	0	To	+350	-18	To	+177
Y	0	To	+650	-18	To	+343
Bespoke	As Specified by User					

CDI Compound		Media	Temp	Δ H Pts	Δ M %	Δ V %	Δ T %	Δ E %	Δ M50 %	Δ 100 %	Visual
803-80	80a HNBR	DD/EE	155°C	-11.8 i	+12.2	+16.6	-28.4	-16.9	-17.8	-12.8	no damage
809	90a HNBR	DD/EE	155°C	-6.2 i	+8.7	+10.7	-9.8	-12.7	-10.8	+4.1	no damage
809	90a HNBR	FF/HH	150°C	-5.6 a	+12.1	+13.8	-9	-21	-11	+14	no damage
901-75	75a FKM	DD/EE	155°C	-5.4 i	+2.9	+6.6	-26.8	-12.1	-9.8	-3.7	no damage
901-90	90a FKM	DD/EE	155°C	-5.6 i	+2.4	+5.1	-15.1	-4.8	-6.2	-8.1	no damage
703	PPS Filled PTFE	FF/HH	202°C	-10.2 d	+4.0	+4.4	-8.6	-18.1	-8.9	-3.2	no damage
711	Carbon Filled PTFE	FF/HH	202°C	-8.2 d	+2.1	+3.0	-22.3	0	-20.7	-17.6	no damage
716	Graphite Filled PTFE	FF/HH	202°C	-6.8 d	+1.2	+2.2	-8.7	-12.4	-4.3	+1.5	no damage
782	Carbon Filled PTFE	FF/HH	204°C	--	+1.1	+2.2	-8.5	-1.0	--	--	no damage
777	Unfilled Modified PTFE	FF/HH	204°C	--	+0.7	+1.8	+8.2	+1.2	--	--	no damage
745	Virgin Unfilled PEEK	FF/HH	204°C	--	+2.6	+2.6	+18.1	+0.3	--	--	no damage
A450	Virgin Unfilled PEEK	FF/HH	204°C	--	+2.5	+2.8	+4.0	-2.1	--	--	no damage
754	Carbon Filled PEEK	FF/HH	202°C	-4.0 d	+3.0	+2.8	-44.8	+2	--	--	no damage
A451	Carbon Filled PEEK	FF/HH	204°C	--	+1.9	+2.2	+20.0	+6.1	--	--	no damage

Hardness (a=Type-A,d=Type-D,i=IRHD), Mass, Volume, Tensile, Elongation, Modulus @ 50%, Modulus @ 100% and visual are evaluated.
More detailed test information is available upon request from CDI Energy Products.

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