PUSHING THE BOUNDARIES OF PERFORMANCE, EFFICIENCY & SUSTAINABILITY

Enabling game-changing energy reduction at data centres

Definitions & cautionary note

Cautionary Note

The companies in which Shell plc directly and indirectly owns investments are separate legal entities. In this [report] "Shell", "Shell Group" and "Group" are sometimes used for convenience where references are made to Shell plc and its subsidiaries in general. Likewise, the words "we", "us" and "our" are also used to refer to Shell plc and its subsidiaries in general or to those who work for them. These terms are also used where no useful purpose is served by identifying the particular entity or entities. ''Subsidiaries'', "Shell subsidiaries" and "Shell companies" as used in this [report] refer to entities over which Shell plc either directly or indirectly has control. The term "joint venture", "joint operations", "joint arrangements", and "associates" may also be used to refer to a commercial arrangement in which Shell has a direct or indirect ownership interest with one or more parties. The term "Shell interest" is used for convenience to indicate the direct and/or indirect ownership interest held by Shell in an entity or unincorporated joint arrangement, after exclusion of all third-party interest.

Forward-Looking Statements

This [report] contains forward-looking statements (within the meaning of the U.S. Private Securities Litigation Reform Act of 1995) concerning the financial condition, results of operations and businesses of Shell. All statements other than statements of historical fact are, or may be deemed to be, forward-looking statements. Forward-looking statements are statements of future expectations that are based on management's current expectations and assumptions and involve known and unknown risks and uncertainties that could cause actual results, performance or events to differ materially from those expressed or implied in these statements. Forward-looking statements include, among other things, statements concerning the potential exposure of Shell to market risks and statements expressing management's expectations, beliefs, estimates, forecasts, projections and assumptions. These forward-looking statements are identified by their use of terms and phrases such as "aim"; "ambition"; ''anticipate''; ''believe''; "commit"; "commitment"; ''could''; ''estimate''; ''expect''; ''goals''; ''intend''; ''may''; "milestones"; ''objectives''; ''outlook''; ''plan''; ''probably''; ''project''; ''risks''; "schedule"; ''seek''; ''should''; ''target''; ''will''; "would" and similar terms and phrases. There are a number of factors that could affect the future operations of Shell and could cause those results to differ materially from those expressed in the forward-looking statements included in this [report], including (without limitation): (a) price fluctuations in crude oil and natural gas; (b) changes in demand for Shell's products; (c) currency fluctuations; (d) drilling and production results; (e) reserves estimates; (f) loss of market share and industry competition; (g) environmental and physical risks; (h) risks associated with the identification of suitable potential acquisition properties and targets, and successful negotiation and completion of such transactions; (i) the risk of doing business in developing countries and countries subject to international sanctions; (j) legislative, judicial, fiscal and regulatory developments including regulatory measures addressing climate change; (k) economic and financial market conditions in various countries and regions; (l) political risks, including the risks of expropriation and renegotiation of the terms of contracts with governmental entities, delays or advancements in the approval of projects and delays in the reimbursement for shared costs; (m) risks associated with the impact of pandemics, such as the COVID-19 (coronavirus) outbreak, regional conflicts, such as the Russia-Ukraine war, and a significant cybersecurity breach; and (n) changes in trading conditions. No assurance is provided that future dividend payments will match or exceed previous dividend payments. All forward-looking statements contained in this [report] are expressly qualified in their entirety by the cautionary statements contained or referred to in this section. Readers should not place undue reliance on forward-looking statements. Additional risk factors that may affect future results are contained in Shell plc's Form 20-F for the year ended December 31, 2023 (available at www.shell.com/investors/news-and-filings/sec-filings.html and www.sec.gov). These risk factors also expressly qualify all forward-looking statements contained in this [report] and should be considered by the reader. Each forward-looking statement speaks only as of the date of this [report], [*insert date*]. Neither Shell plc nor any of its subsidiaries undertake any obligation to publicly update or revise any forward-looking statement as a result of new information, future events or other information. In light of these risks, results could differ materially from those stated, implied or inferred from the forward-looking statements contained in this [report].

Shell's Net Carbon Intensity

Also, in this [report] we may refer to Shell's "Net Carbon Intensity" (NCI), which includes Shell's carbon emissions from the production of our energy products, our suppliers' carbon emissions in supplying energy for that production and our customers' carbon emissions associated with their use of the energy products we sell. Shell's NCI also includes the emissions associated with the production and use of energy products produced by others which Shell purchases for resale. Shell only controls its own emissions. The use of the terms Shell's "Net Carbon Intensity" or NCI are for convenience only and not intended to suggest these emissions are those of Shell plc or its subsidiaries.

Shell's net-zero emissions target

Shell's operating plan, outlook and budgets are forecasted for a ten-year period and are updated every year. They reflect the current economic environment and what we can reasonably expect to see over the next ten years. Accordingly, they reflect our Scope 1, Scope 2 and NCI targets over the next ten years. However, Shell's operating plans cannot reflect our 2050 net-zero emissions target, as this target is currently outside our planning period. In the future, as society moves towards net-zero emissions, we expect Shell's operating plans to reflect this movement. However, if society is not net zero in 2050, as of today, there would be significant risk that Shell may not meet this target.

Forward-Looking non-GAAP measures

This [report] may contain certain forward-looking non-GAAP measures such as [cash capital expenditure] and [divestments]. We are unable to provide a reconciliation of these forward-looking non-GAAP measures to the most comparable GAAP financial measures because certain information needed to reconcile those non-GAAP measures to the most comparable GAAP financial measures is dependent on future events some of which are outside the control of Shell, such as oil and gas prices, interest rates and exchange rates. Moreover, estimating such GAAP measures with the required precision necessary to provide a meaningful reconciliation is extremely difficult and could not be accomplished without unreasonable effort. Non-GAAP measures in respect of future periods which cannot be reconciled to the most comparable GAAP financial measure are calculated in a manner which is consistent with the accounting policies applied in Shell plc's consolidated financial statements.

The contents of websites referred to in this [report] do not form part of this [report].

We may have used certain terms, such as resources, in this [report] that the United States Securities and Exchange Commission (SEC) strictly prohibits us from including in our filings with the SEC. Investors are urged to consider closely the disclosure in our Form 20-F, File No 1-32575, available on the SEC website www.sec.gov.

Evolution of Data Center Cooling

Michael Gujral

Crossroads – HPC Computing and Sustainability

The crossroads of sustainability and high-performance computing (HPC) represent a critical intersection where efforts to achieve high computational performance meet strategies to minimize environmental impact.

Key points at this intersection:

- **Energy Efficiency**: Implementing energy-efficient hardware and software solutions to reduce the energy consumption of HPC systems.
- **Renewable Energy Integration**: Increasing the use of renewable energy sources to power HPC facilities, reducing reliance on fossil fuels.
- **Cooling Technologies**: Employing innovative cooling technologies to manage heat generated by HPC systems more efficiently.
- **Lifecycle Management:** Implementing sustainable practices in the lifecycle management of HPC systems, including responsible disposal and recycling of components.
- **Resource Optimization:** Using HPC systems to optimize resource usage in other sectors, such as energy, transportation, and manufacturing, leading to overall sustainability gains.
- **Green Computing:** Developing and utilizing algorithms and software that optimize energy usage and performance in HPC systems.
- **Collaboration and Knowledge Sharing:** Collaborating with industry partners and sharing best practices to drive innovation in sustainable HPC strategies.
- **Policy and Regulation:** Advocating for policies and regulations that promote sustainability in HPC, such as carbon pricing and energy efficiency standards

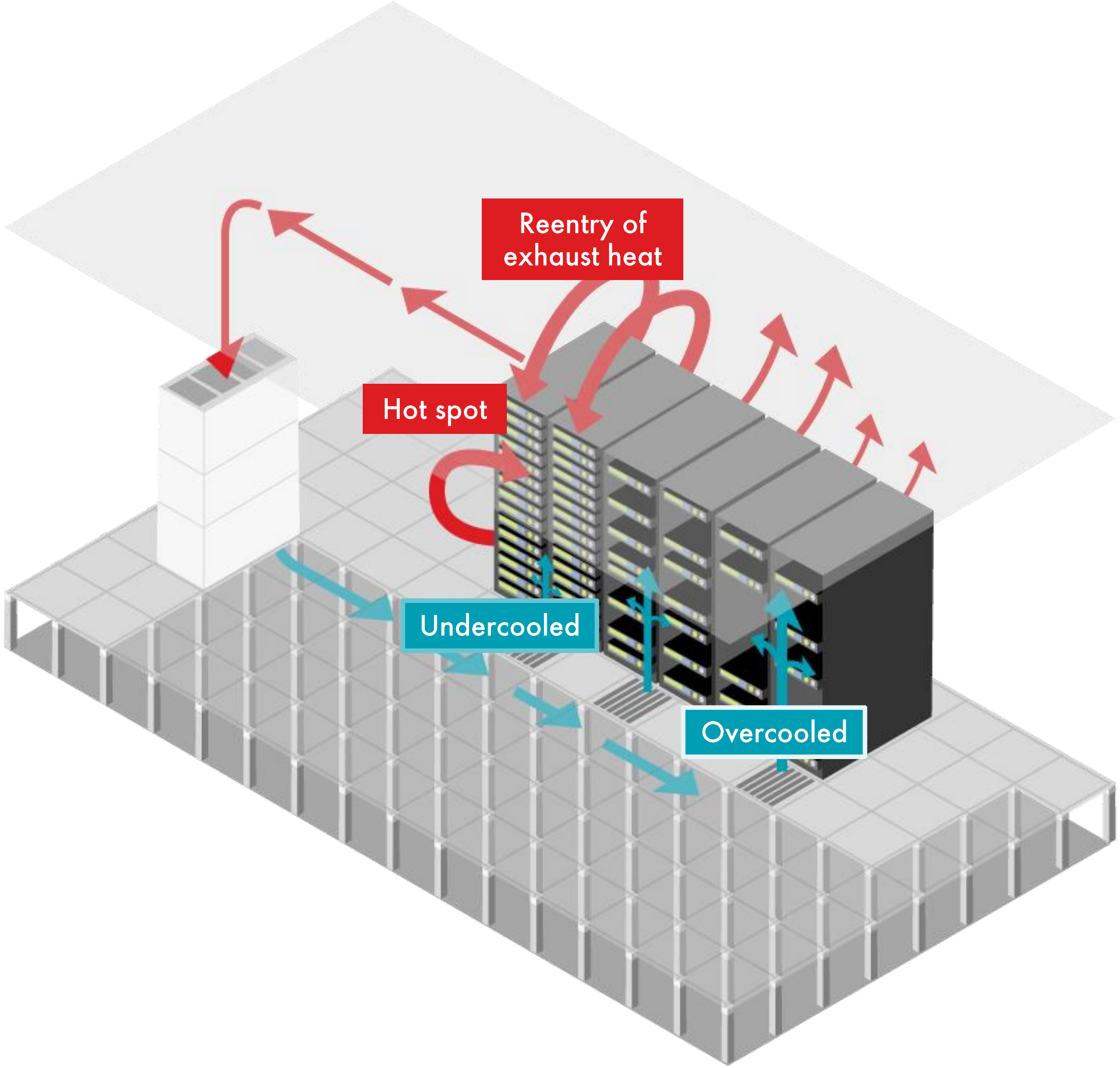
*UPS = uninterruptible power supplies

WHY TRADITIONAL DATA CENTRES STUGGLE TO COMPETE: AIR COOLING

Most traditional data centres use air-cooling methods to cool servers and maintain optimal operating temperatures.

Although popular, air-cooling systems have several disadvantages:

- They are energy intensive (PUEs of 1.5 and higher) and inefficient, resulting in hotspots.
- They consume large amounts of water through evaporative cooling and electricity generation.
- They require large amounts of space to enable sufficient air flow.
- They require extra hardware, including chillers, fans and bearings.
- They typically have to be located in cooler climates at the expense of latency.



THE GROWING CHALLENGE OF SERVER COOLING

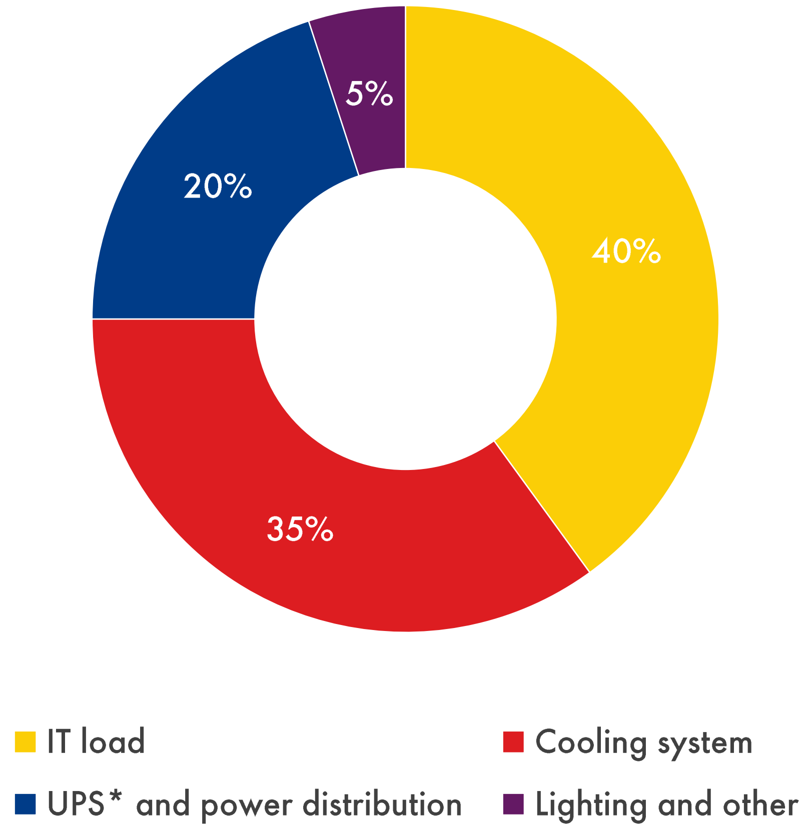
A growing challenge for server operators is keeping servers at the right temperature – as the workload on servers increases, so does the heat generated.

This is especially true as the densities of server ranks are increasing…

If servers get too hot, processing performance decreases while the risk of hardware damage increases.

Keeping servers at the optimal temperature, however, is energy intensive and consumes more than one-third of data centre power consumption.

At least 35% of energy is spent cooling servers.[1]

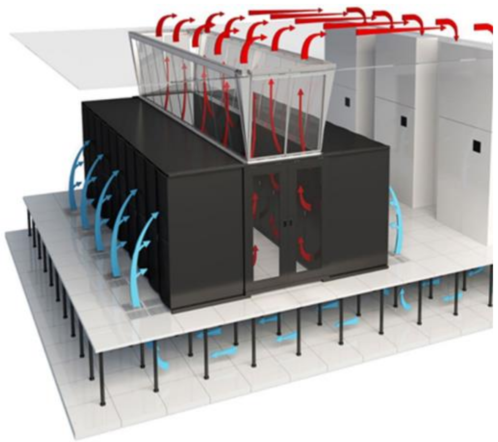


*UPS = uninterruptible power supplies

[1]Source: Yole Développement – Data Center Market and Technology Trends Power Electronics presentation held at APEC 2016

Evolution of data center cooling

Air Cooling



PUE of 1.6 – 2.5

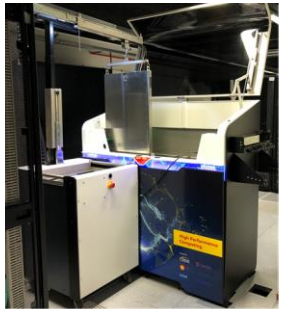
- Most common data center cooling mechanism today
- High noise levels
- Density limit of ~**30KW** per rack
- Exit temperatures of around 120°F (~50°C)

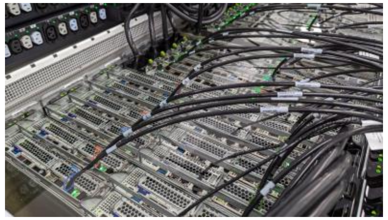
Direct Liquid Cooling

PUE of 1.2 – 1.5

- Utilizes a water/glycol-based coolant to remove heat from the hottest components, e.g. CPUs & GPUs
- Density limit of ~**62KW** per rack
- Exit temperatures of around 80°F (~26°C)

Single-phase Immersion Cooling





PUE of 1.04 – 1.1

- Systems are fully immersed in a non-conductive liquid
- Shell deployments:
  - Asperitas system (1) in Amsterdam
  - GRC IceRAQ Duos (6) in Houston
- Density limit of up to **100KW** per rack

Data centre cooling

DEVELOPING AN ECOSYSTEM THAT IS IMMERSION READY

Shell is collaborating with nearly all major OEM’s to prepare the industry for immersion ready servers & infrastructure

Immersion Cooling

Punith Shivaprasad

SINGLE-PHASE IMMERSION COOLING DELIVERS SIGNIFICANT BENEFITS

Single-phase immersion cooling is the most cost-effective and sustainable method for cooling server banks, especially high-density racks of 50 kW and more.

Single-phase immersion cooling requires specially formulated cooling fluids...

Compared with air cooling, single-phase immersion cooling offers:[1]

Performance

UP TO
40%
greater CPU performance

Cost

UP TO
48%
less electricity consumption

UP TO
80%
smaller physical footprint

Sustainability

AROUND
99%
less water consumption

UP TO
99%
energy ready for reuse as 55°C hot water

UP TO
30%
lower CO_2 footprint

[1]Figures based on: Global immersion cooling market in data centres – growth, trends and forecast (2019-2024) report (Mordor Intelligence) and Shell's internal evaluations. Benefits achieved will vary according to actual site development.

INTRODUCING SHELL'S RANGE OF IMMERSION COOLING FLUIDS

Specifically developed for use in single-phase immersion cooling systems

Shell's current range of immersion cooling fluids has been specifically developed for use in single-phase immersion cooling systems (pumped and natural convection).

Made from natural gas using Shell's industry-leading gas-to-liquids (GTL) process, Shell Immersion Cooling Fluid S5 X and S3 X have been designed to maximise the energy efficiency and performance of data servers and IT components.

To ensure that we can meet a wider range of immersion cooling needs, we are also developing alternative immersion cooling products that will provide a wider choice of immersion cooling solutions.

Shell Immersion Cooling Fluid S3 X for high-performance and edge computing

Shell Immersion Cooling Fluid S3 X is a synthetic, single-phase immersion cooling fluid designed for the needs of high-performance computing, edge computing and blockchain applications

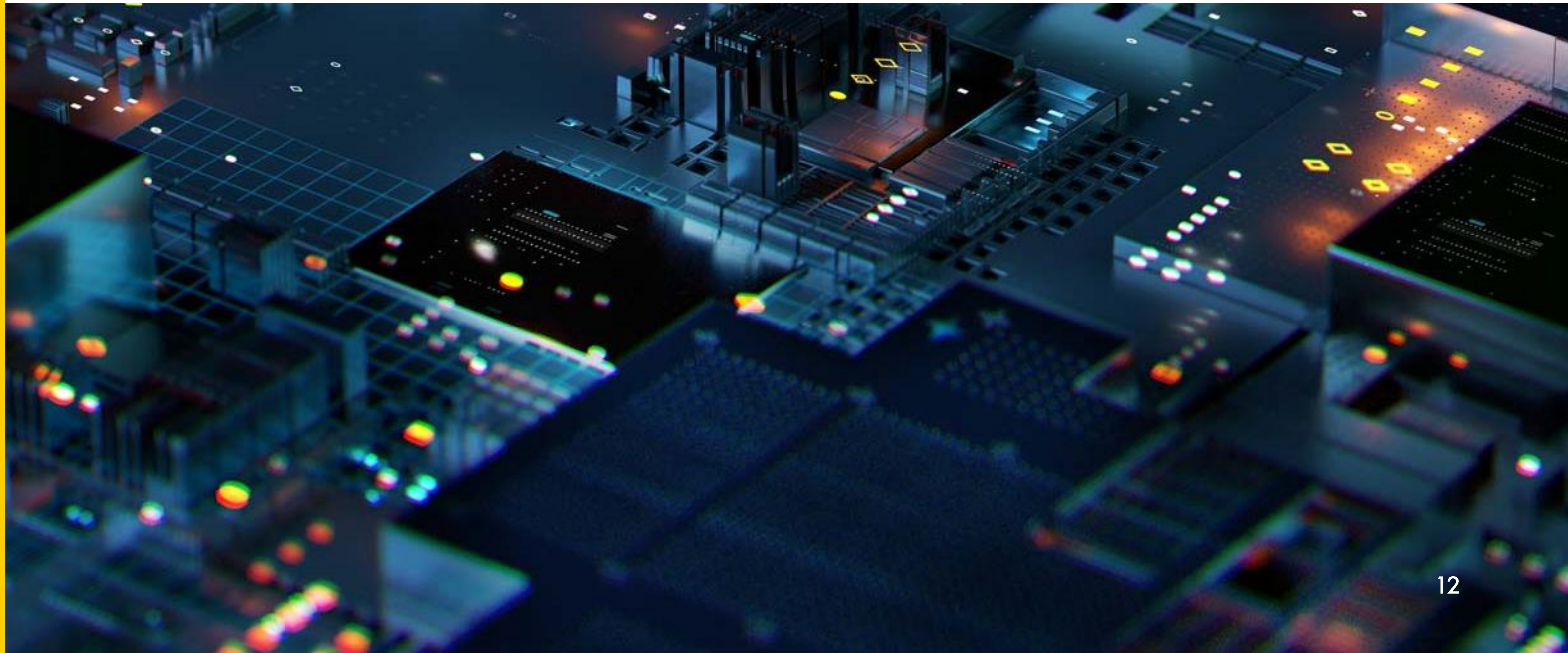
Benefits:

- **Reduced energy costs and emissions.** High cooling efficiency, flow behaviour and excellent thermodynamic properties mean you need less energy to run your network.
- **Environment agnostic.** Set your network up without worrying about environmental interference, such as hot, humid or dusty locales.
- **Safe and easy to handle.** Can contribute to a safer working environment for your staff.
- **High compatibility.** Suitable for use with almost all computer components.[1]

[1]Shell Global. Clean energy solutions. Retrieved April 22, 2021, from www.shell.com/business-customers/trading-and-supply/trading/shell-energy-europe/clean-energy-solutions.html

Properties			Method	Shell Immersion Cooling Fluid S3 X
Colour (Saybolt)	-	-	ASTM D156	>+30
Density	@15°C	kg/m³	ASTM D4052	808
Flash point	-	°C	ASTM D92	198
Pour point	-	°C	ASTM D97	-42
Kinematic viscosity	@40°C	mm²/s	ASTM D445	9.9
Kinematic viscosity	@0°C	mm²/s	ASTM D7042	52.3
Neutralisation value	-	mgKOH/g	IEC 62021-1	<0.01

These characteristics are typical of the research product, variations in these characteristics may occur.

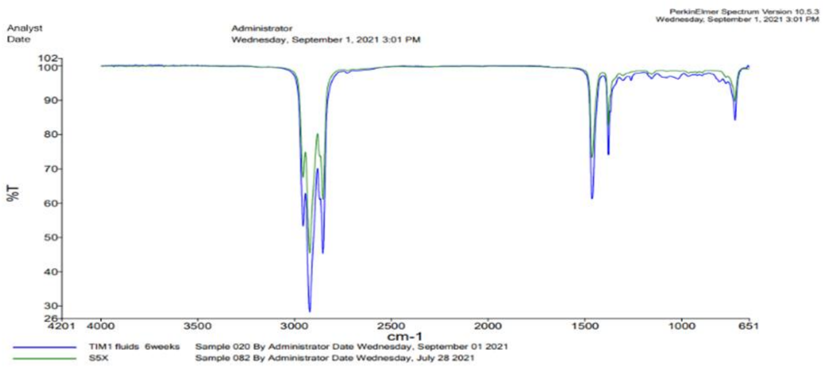


OVERCOMING MATERIAL COMPATIBILITY CHALLENGES

Working together with major OEM's to develop immersion ready hardware

- Power & Optical Cables Through in-house testing with OEM's, identified new cable materials that won't harden or swell
- Thermal Interface Materials Immersion compatible TIM's have been identified
- Capacitors EPDM rubbers have historically been a challenge

FTIR Spectroscopy



Shell immersion cooling fluids: Compatibility Guide[1]

Materials type	Material description	Component normally used	Compatibility
Metal	Silver	Conductors	Suitable
Metal	Copper	Conductors	Suitable
Metal	Aluminium	Connectors	Suitable
Metal	Steel	Structure parts	Suitable
Metal	Zinc	Coatings	Suitable
Elastomer	FKM/Viton	Cooling tubes/piping	Suitable
Elastomer	CR (chloroprene)	Sealings	Suitable
Elastomer	MFQ (fluorsilicone rubber)	Sealings	Suitable
Elastomer	PU (polyurethane)	Connectors	Suitable
Plastic	Polypropylene without plasticiser	Tanks	Suitable
Plastic	HDPE without plasticiser	Cables/wiring insulation	Suitable
Plastic	PTFE (polytetrafluoroethylene)	Sealings	Suitable
Plastic	Hard PVC without plasticiser	Cables/wiring insulation	Suitable
Plastic	Polyamide	Cooling tubes/piping	Suitable
Plastic	PC (polycarbonate)	Connectors	Suitable
Plastic	PETG (polyethylene terephthalate glycol-modified)	Cooling tubes/piping	Suitable
Plastic	POM (polyoxymethylene)	Connectors	Suitable
Plastic	PS (polystyrene)	Structure parts	Suitable
Elastomer	EPDM (ethylene propylene diene monomer)	Seals/connections	Not recommended

[1]This is a generic compatibility guideline based on tests performed at our laboratories. The components are normally made from different materials and formulations; therefore, the compatibility behaviour may differ from each component supplier. For detailed investigation about component compatibility performance, Shell is ready to perform detailed compatibility tests if the parts are sent to our laboratories.