15-24

Plastic – Tap fittings

Title	DETERMINATION OF THE SOURCE OF A SMELL
Date	2013
Objective	To determine the source of a bad smell from a tap fitting
Testing Undertaken	Polymer insert in tap assembly tested by IR spectroscopy O ring, circlip and insert in tap assembly tested by SPME GC-MS
Conclusion	The IR spec matched that of Noryl. Result of SPME GC-MS was that most abundant compound was: Pentanoic acid, 2,2,4-trimethyl-3-carboxyisopropyl, isobutyl ester

Plastic coating on aluminium – Panels

Title	INVESTIGATION OF ADHESION FAILURE OF COATING TO ALUMINIUM PANELS

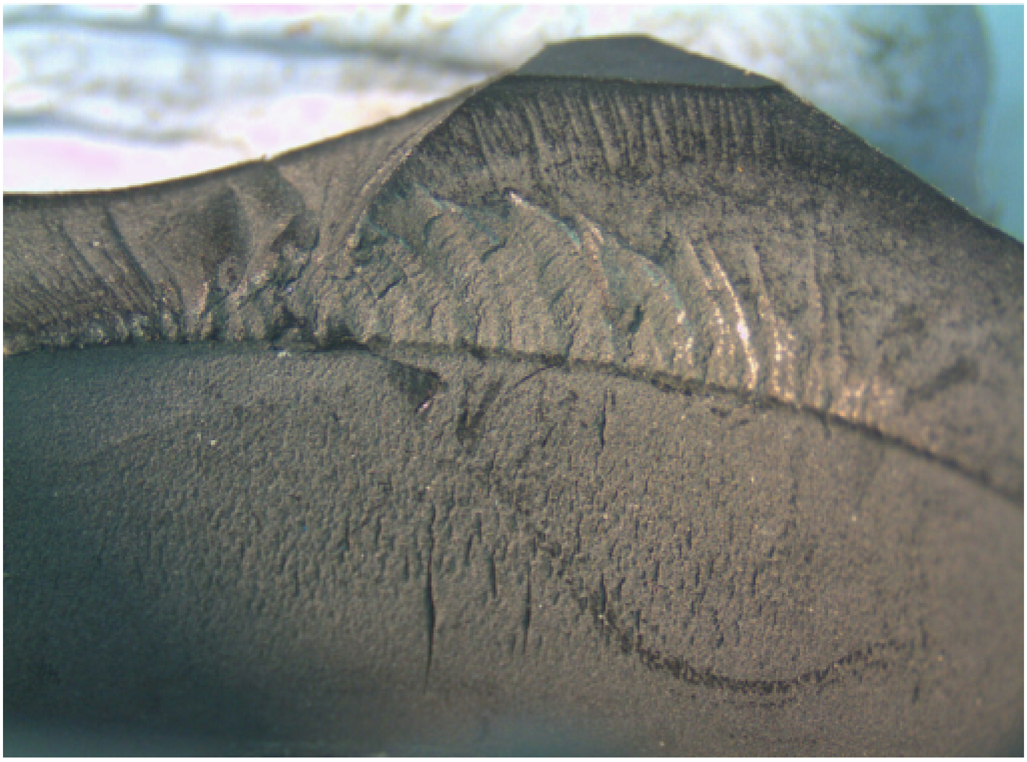
Date	2013
Objective	To investigate the origin of adhesion failure of an organic coating on a surface treated aluminium sheet.
Testing Undertaken	ToF-SIMS analysis Surface topography by SEM
Failure Mode	The sample M exhibiting poor coating adhesion had high magnesium levels (2500 counts) and calcium levels (12000) counts (i.e. relatively high levels of hard water residues). The samples M and B exhibiting good adhesion had low magnesium levels (400; 100 counts) and very low calcium levels (200-500 counts). This suggested a strong correlation between magnesium and calcium deposits on the aluminium surface and the degree of coating adhesion. SEM revealed that sample M and B had a similar degree of surface pitting. Pit types observed: narrow deep, elliptical, wide shallow, subsurface and undercutting pits.

Polyvinyl chloride (PVC) – Fabrics

Title	PLASTICISER CONTENT OF A FABRIC SAMPLE
Date	2013
Objective	To measure the plasticiser properties of a sample of PVC fabric samples
Testing Undertaken	PVC extracted using diethyl ether. Resultant ether solution heated until ether evaporated, mass of residue measured and percentage residue calculated.

Conclusion	PVC fabric using a polymeric plasticiser would have a much longer service life than a PVC fabric having a normal long chain ester plasticiser.

Polyacetal – Plastic nuts

Title	IDENTIFICATION OF FRACTURED PLASTIC NUT COMPONENTS
Date	2012
Objective	To identify the composition of fractured plastic nut components with a view to determining the cause of the failure.
Photo	 Figure 1. Fracture surface of plastic nut
Testing Undertaken	FTIR by horizontal attenuated total reflectance (HATR)
Failure Analysis	The fractures samples were composed of Polyacetal (POM). Failure was possibly due to the parts undergoing oxidative stress cracking brought about by UV exposure. However, the parts were also exposed to hot water and it is very likely that the parts had degraded by hydrolysis which created formic acid and catalysed further hydrolysis, leading to degradation and embrittlement.

Polybutylene – Water pipes

Title	FAILURE ANALYSIS OF POLYBUTYLENE WATER PIPE
Date	2012
Objective	To investigate the cause of failure of a sample of polybutylene water pipe
Photo	 Figure 1. Failure site – ductile/brittle failure. Note scuff marks near failure
Testing Undertaken	Failure analysis Wall thickness analysis
Failure Analysis	The pipe failed prematurely by ductile failure (Stage 1 failure), most likely due to over pressurization by operating pressure excursion. There is also some evidence of brittle failure, thus the failure is best characterized as ductile-brittle hybrid failure

Polycarbonate – Injection mouldings

Title	FAILURE ANALYSIS OF CRACKED MOULDINGS
Date	2013
Objective	To investigate the origin of cracking of a polycarbonate injection moulded top

	cover for a mine application.
Photo	 Figure 1. Crack in top cover Description: Description: Description: Description: Description: Description: Description: Description: Description: Description: Description: Description: Description: Description: Description: Description: D:\Work\Failure Analysis Reports # 2300 - 3799\resized_files\image194.png Figure 2. Close up of cracking in top cover. Multiple crack fronts visible

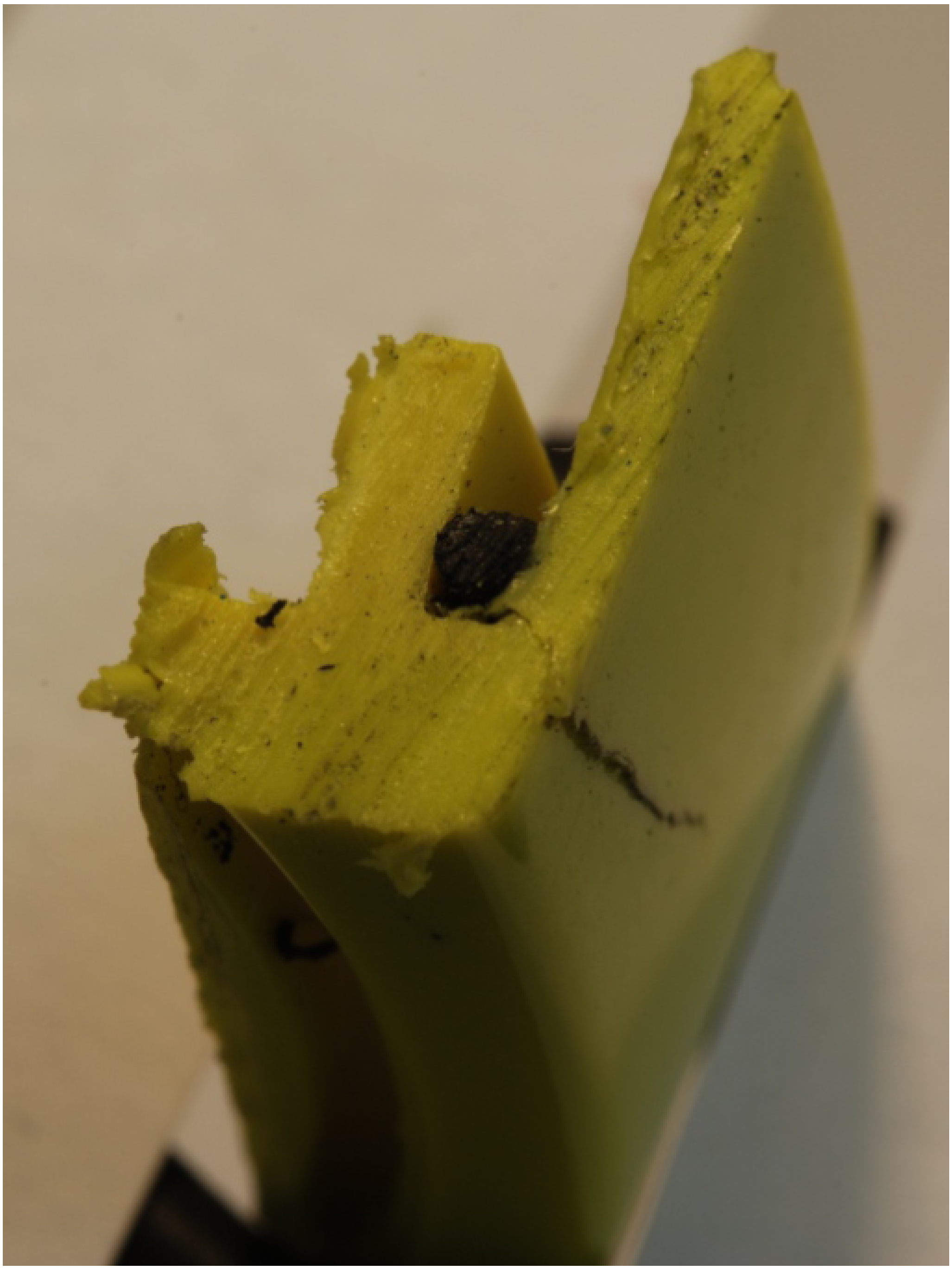
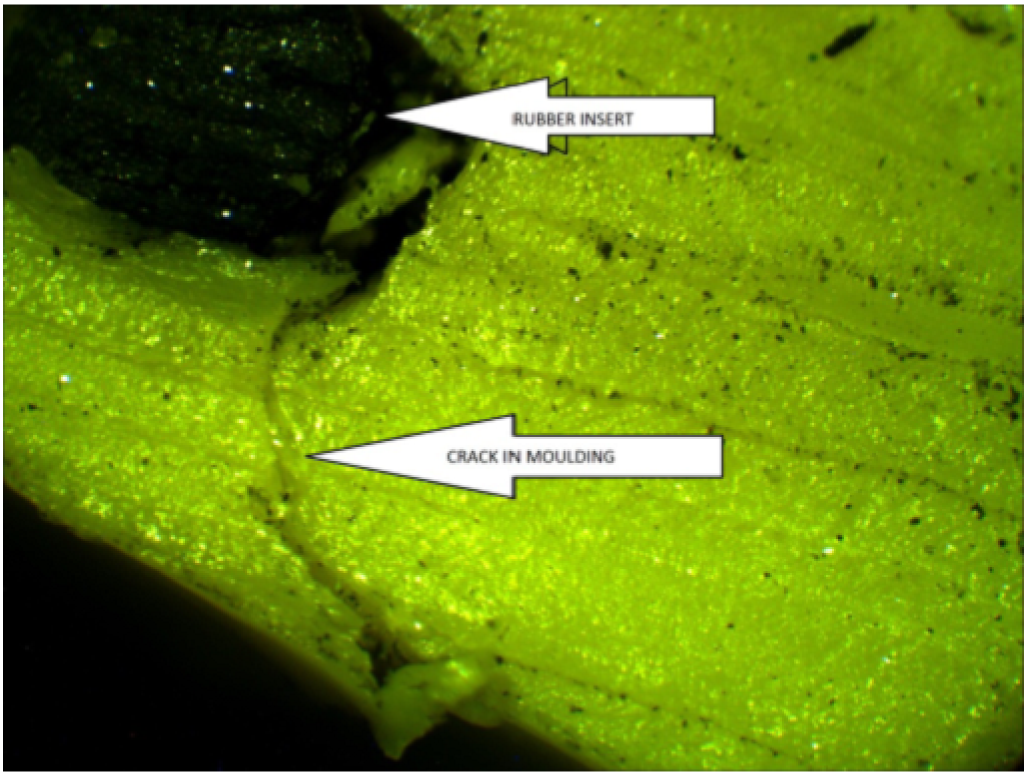
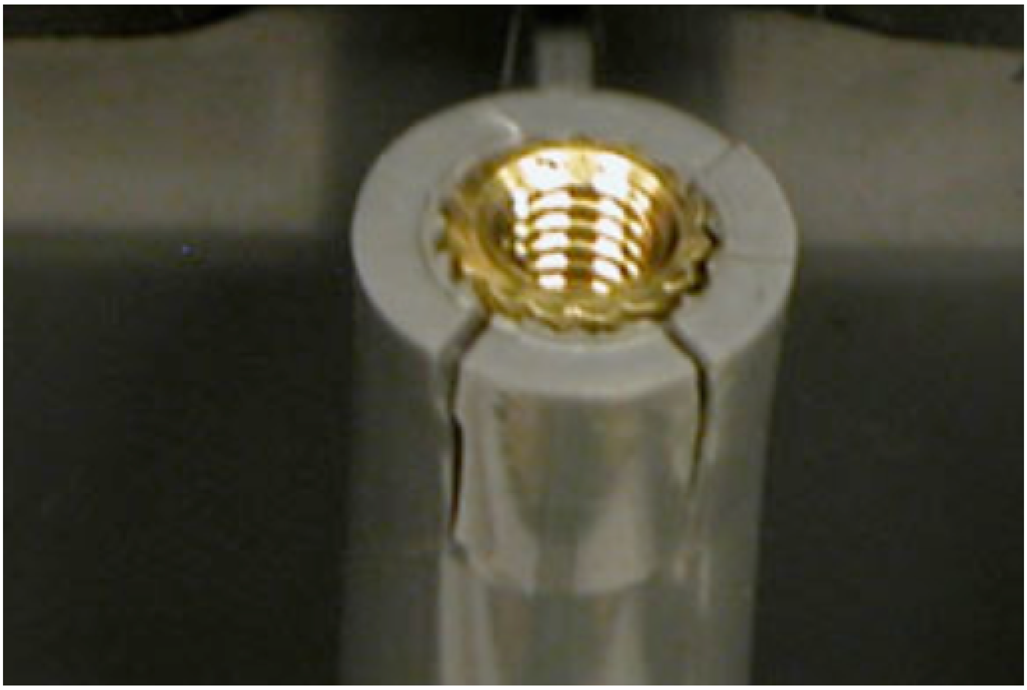
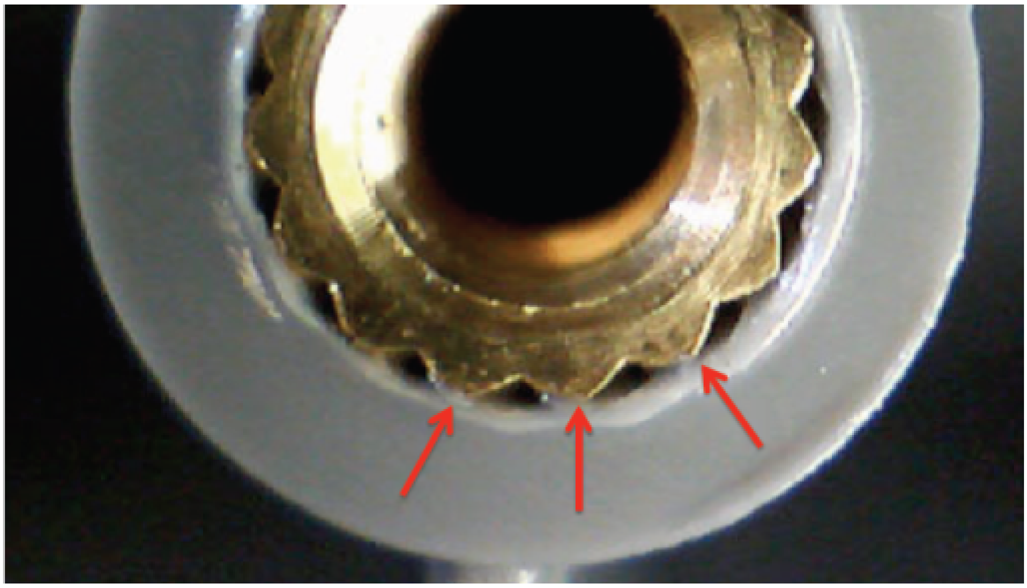


Figure 3. Cross section of crack in top cover. Cracking seen to initiate at root of groove where o-ring is

	 Figure 4. Cracking position in side wall (originating at groove for rubber insert)
Testing Undertaken	Photomicroscopy Solvent Extraction IR spectroscopy
Failure Mode	Brittle nature of cracks and appearance of multiple crack junctions was indicative of environmental stress cracking. The cracking was traced back to the presence of the rubber insert. The rubber insert was chemically analysed and found to be made of an oil-extended styrene-co-isoprene synthetic rubber. The oil extender in the rubber appears to be a strong stress cracking agent for polycarbonate.

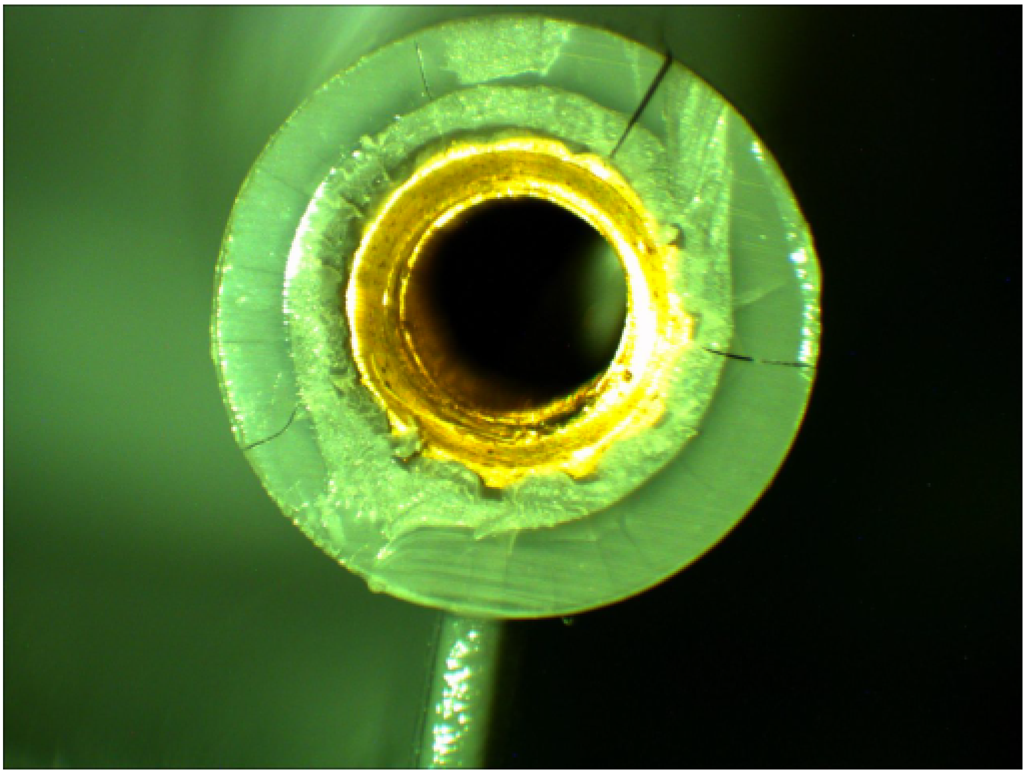
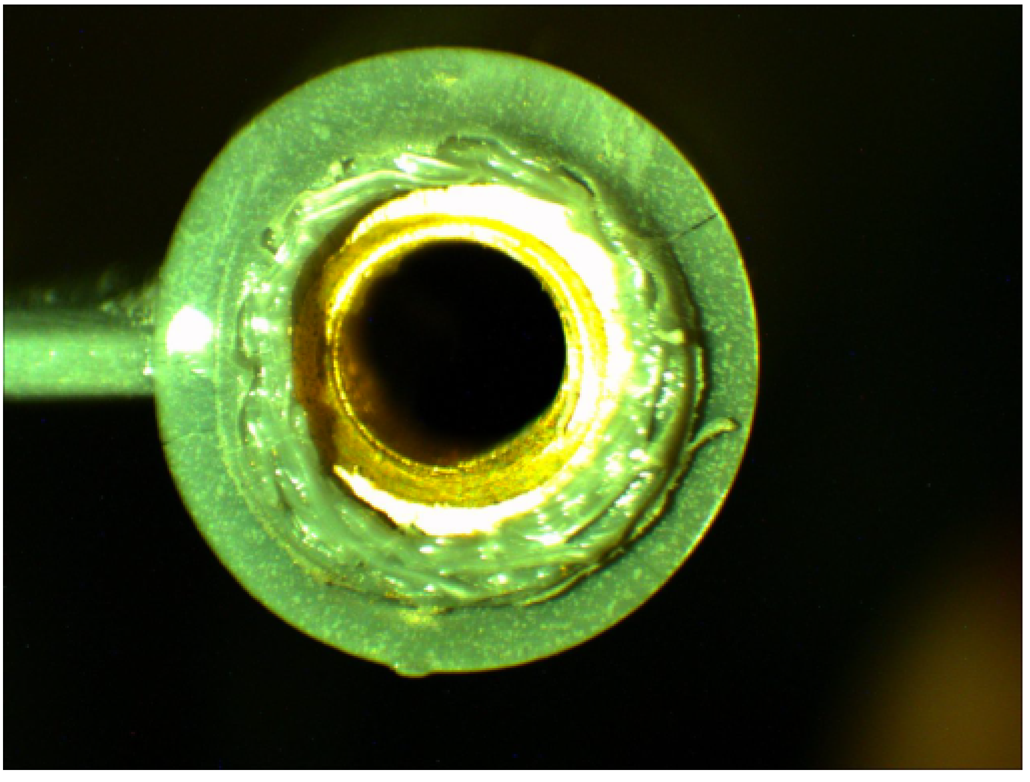
Polycarbonate – Mouldings (1 of 2)

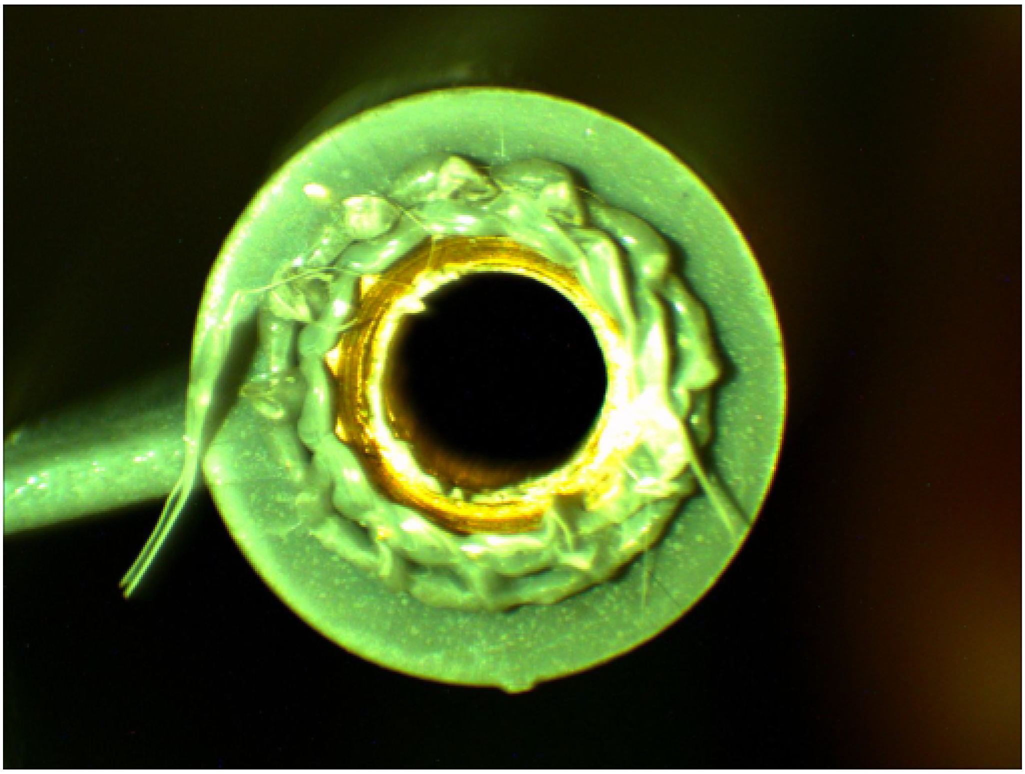
Title	FAILURE ANALYSIS OF INJECTION MOULDED POLYMER CASES
Date	2013
Objective	To identify the cause of hairline cracks in polycarbonate mouldings.
Photo	

	 Figure 1. Failure mode of polycarbonate mouldings  Figure 2. Star boss design creates stress concentrations
Testing Undertaken	IR analysis Failure analysis
Failure Analysis	The hairline cracks in the polycarbonate mouldings were due to: stress cracks from shrinkage around the metal inserts, and oily residue on brass inserts which promoted stress cracking.

Polycarbonate – Mouldings (2 of 2)

Title	STRESS ANALYSIS OF INJECTION MOULDED POLYCARBONATE

	CASES
Date	2013
Objective	To test a number of polycarbonate moulded 10.4-inch cases that have been subjected to different treatments to advise the best treatment strategy in order to minimise boss cracking around the threaded metal inserts
Photo	 Figure 1. Moulding 1 after immersion  Figure 2. Moulding 2 after immersion

	 Figure 3. Moulding 3 after immersion
Testing Undertaken	Stress tested by immersion in a 50/50 vol./vol. methanol/ethyl acetate blend for 3 minutes as per GE Plastics Testing Procedure. Then examined for the presence of stress cracking and number of cracks recorded using travelling digital microscope
Conclusion	The moulded-in stresses in all cases in the area directly around the metal inserts were greater than 500 psi.

Polycarbonate; Polyether sulfone (PES) – Mouldings

Title	IDENTIFICATION OF UNKNOWN POLYMER SAMPLES AND CAUSE OF FAILURE
Date	2013
Objective	To determine the identity of an unknown polymer sample, and determine the cause of failure.
Photo	

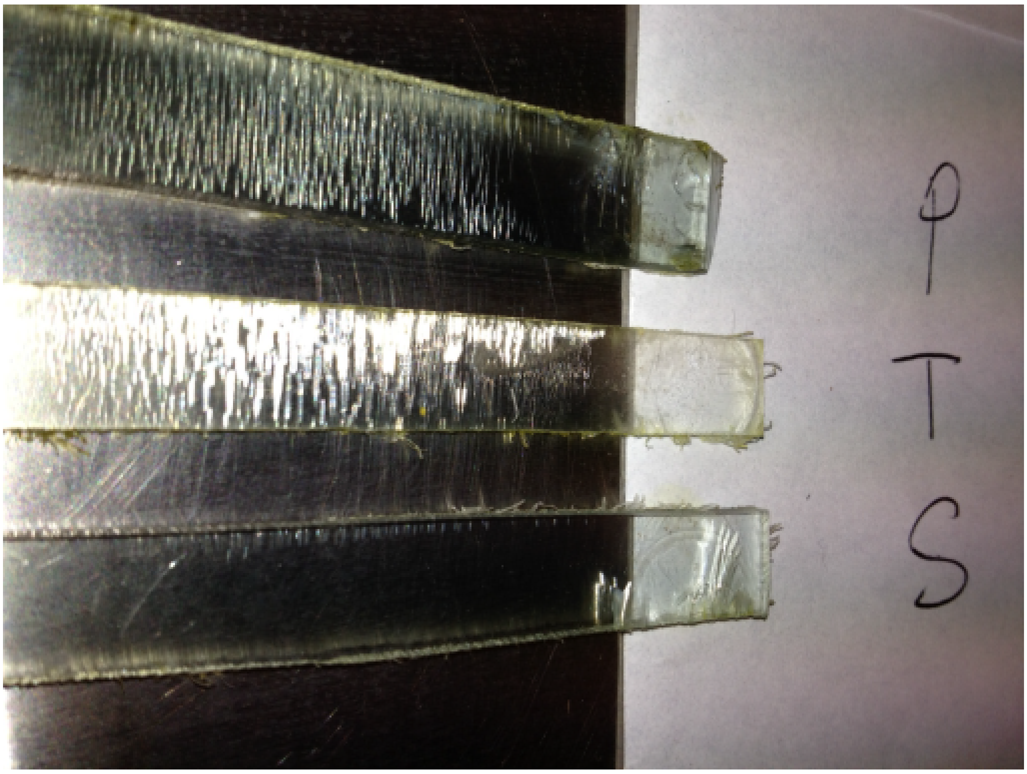
Figure 1. Photograph of handle and switch plate

Figure 2. Photograph of handle showing multiple crack fronts initiated from a sharp moulded in notch at the point where the gripping teeth are present

Testing Undertaken	FT-IR (per ASTM E573) DSC (per ASTM D 3418)
Failure Analysis	Handle: The handle material was Poly(ethersulfone) (PES). The nature of the cracking on the handle was highly suggestive of stress cracking as the material was locally embrittled and there were multiple crack fronts (see Figure 2). It was likely that the handle had been in contact with a disinfectant or cleaning chemical based on some organic chemicals (such as ketones, esters, DMSO, aromatic amines, nitrobenzene and some chlorinated hydrocarbons) Switch plate: The switch plate material was most likely polycarbonate (PC). The failure was also due to stress cracking and may have been due to the same type of chemicals that affected the PES handle.

Polycarbonate; SAN; Tritan – Appliances

Title	STRESS CRACKING RESISTANCE OF AMORPHOUS POLYMERS
Date	2013
Objective	To investigate the sensitivity of various clear amorphous polymers to stress cracking in the presence of d-limonene, orange oil and lime oil. The polymers were from fruit juice extractor components
Photo	 Figure 1. Results of Moderate Strain Test (dia. 400 mm). Note crazing on all three samples

	 Figure 2. Results of Low Strain Test (dia. 600 mm). Note that SAN has not yet crazed.
Testing Undertaken	ISO 22088-2:2006 Plastics – Determination of resistance to environmental stress cracking (ESC) – Part 3 Bent Strip Test. The following three citrus essential oils components were used as stress cracking agents: D-limonene, orange oil and lime oil.
Conclusion	All three polymers (PC, SAN and Tritan™) underwent crazing and stress cracking under high and moderate strain. In the low strain test only SAN was most resistant followed by PC and then Tritan™. Tritan underwent stress cracking the quickest in all tests with all media tested.

Polycarbonate; Tritan – Appliances

Title	IZOD IMPACT STRENGTH MEASUREMENT OF POLYMER SAMPLES
Date	2013
Objective	To measure the izod impact strength of polymer samples
Photo	

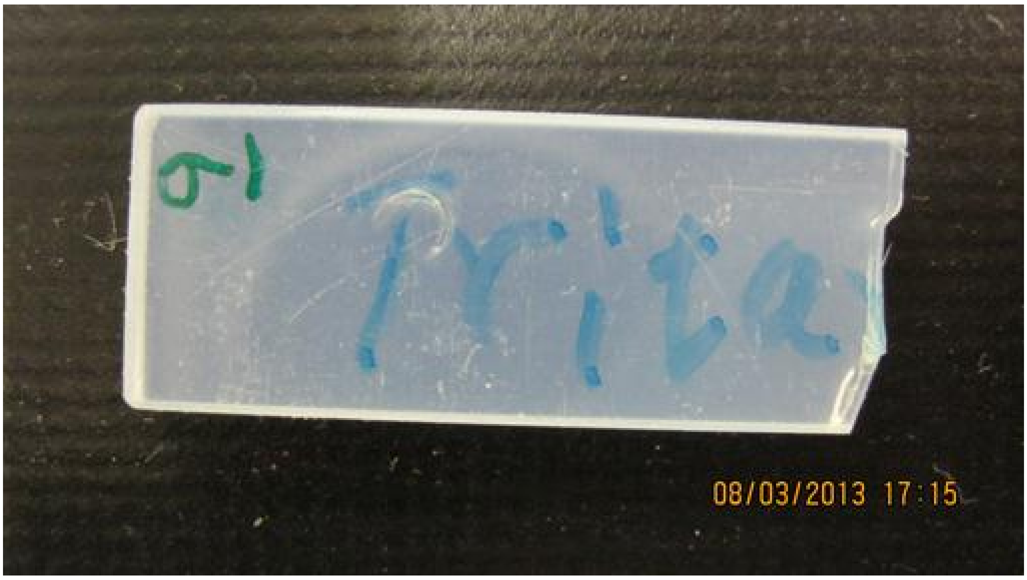


Figure 1. Tritan specimen showing translucent effect after immersion in d limonene. No damage from notching apparatus

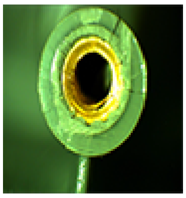
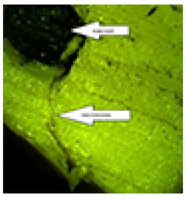
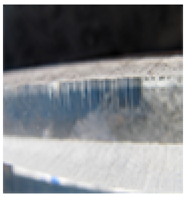
Figure 2. Polycarbonate specimen showing effect of immersion in d-limonene. Evidence of severe stress cracking at points where specimen held in notching apparatus.

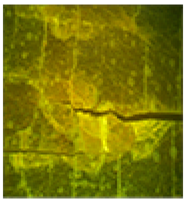
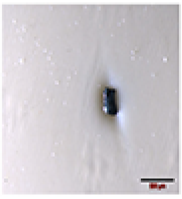
	 Figure 3. Stress cracking of Polycarbonate specimen after immersion in d limonene
Testing Undertaken	Izod Impact Strength measurement testing according to ASTM D 256 using Test Method A
Conclusion	D limonene can cause stress cracking of polycarbonate.

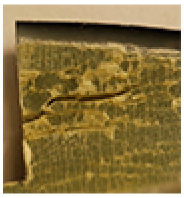
- [Insurance Claims]
- [Turnaround Times]

Accreditation

Gallery

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