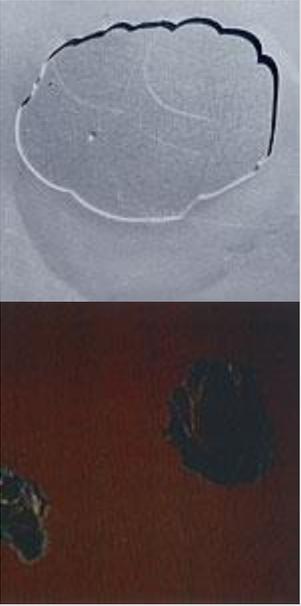
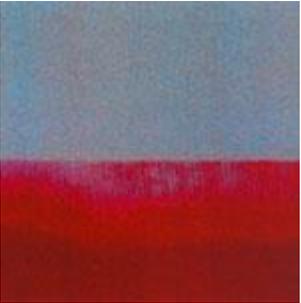


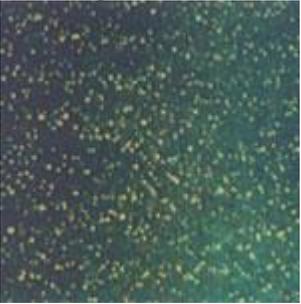
Gel Coat Faults, Causes and Remedies

Using the correct design, equipment, technique and materials, it is not difficult to obtain perfect results using contact moulding, particularly after some experience has been obtained.

Should a fault occur, however, the following schedule will assist in identifying its nature its cause and suggest steps to rectify the problem.

Fault	Description	Cause	Remedy
<p>In Wet Gel Coat Cratering or Air Bubble.</p> 	<p>Failure of coating to form continuous, unbroken film leaving round or irregular shaped bare patches.</p>	<ol style="list-style-type: none"> 1. Contamination of mould surface. 2. Contamination of, or wrong release agent. 3. Contamination of gel coat. 4. Gel Coat type 5. Air Pockets 	<p>Wash mould surface with detergent and water – then polish.</p> <p>Check that wax release agent does not contain silicones etc.</p> <ol style="list-style-type: none"> a. Check that all equipment and tools are clean and that there are no oil leaks. b. Ensure that air supply to spray equipment is clean and dry. <p>Change Gel Coat.</p> <p>Check roll-out procedures</p>
<p>Draining or Bleeding</p>	<p>Movement of the gel coat particularly on vertical surfaces.</p>	<ol style="list-style-type: none"> 1. Gel Coat film too heavy. 	<ol style="list-style-type: none"> a. Avoid film build up thicker than 0.8mm or 800gsm. b. Apply two mist coats 0.1 to

	<p>Colour variation following lines of draining.</p> <p>Laminate Bleed (Cosmetic problem only)</p>		0.2 mm thick followed by final build up to 0.6 to 0.8mm.
		2. Addition of styrene or solvent to reduce viscosity.	Do not dilute gel coat. with anything unless recommended.
		3. Striping gel coat sagging over cured gel coat.	Check sag resistance of 'striping' gel coat. Spray stripe coat as soon as possible.
		4. Monomer in laminating resin.	Check for excessive monomer in laminating resin.
		5. Gel Coat back side cure.	Change gel coat.
Jagged tape lines	Tape lines that are jagged.	Gel Coat starting to gel.	Use less catalyst (do not go below recommended minimum). Use the double tape process. Use good tape recommended for fine lines..
<p>Mottling and Dull or soft spots at random</p> 	Variation in colour density.	1. Application by brush.	Do not use brush to apply gel coat.
		2. Movement due to air from spray gun blowing on gel coat. film.	a. Avoid excess atomization. b. Reduce atomizing air to minimum.
		3. Poor atomization.	Adjust atomization.
		4. Gel Coat uneven	Poor breakup, use three passes.
		5. Catalyst poorly mixed into gel coat and/or laminate	Mix catalyst thoroughly. Improper catalyst settings. Gun held too closely to mould.
		6. Trapped solvent in gel coat and/or laminate.	Check cleaning procedure.
		7. Trapped water in gel coat and/or laminate.	Drain lines and correct the problem.

		8. Insufficient catalyst.	Confirm correct catalyst concentration.
Pigment Darting 	Pigment darting or specks forming on surface.	1. Contamination.	Clean pump and lines.
		2. Foreign particles	Strain and keep material covered. Keep overspray minimized. Moulds must be clean. Spray perpendicular to mould surface.
Porosity 	Small spaces/spots in gel coat.	1. Entrapped air.	Wrong air pressure.
		2. Wrong catalyst.	Check gel coat recommendations.
		3. No catalyst.	Check catalyst supply and alignment.
		4. Gel Coat film thickness	Applied too thick. Use 18 plus minus 2 ml wet. Apply in two to three passes.
		5. Formulation	Improper viscosity and/or resin solids.
		6. Water or solvent.	Check cleaning procedure.
		7. Pump cavitation.	Check pump for air leaks.
		8. Excessive mixing.	Mix once a day for 10 minutes only.
Resin Tearing	Resin Separation	1. Pigments separate from resin.	Check for sources of water contamination.
		2. Application.	Avoid over-spray. Improper spray techniques create excessive over-spray, droplets and flooding. Can

			<p>be aggravated by long gel time and sagging. Do not allow overspray to dry; keep a wet line.</p>
<p>Sags and Runs</p>	<p>Gel Coat sags and runs.</p>	<ol style="list-style-type: none"> 1. Excessive gel coat. 2. Spray techniques. 3. Low viscosity. 4. Mould wax. 5. Other. 	<p>Apply 18 plus minus 2ml, wet.</p> <p>Atomizing air is pushing and blowing the gel coat. Not enough styrene is being volatilized.</p> <p>Check viscosity and thixotropic properties. Over agitated. Material was reduced, but should not have been.</p> <p>Silicone content too high.</p> <p>Jarring the mould before gelation.</p>
<p>Silking or Linear Cissing</p> 	<p>Comet shaped streaking with darker tone at the head of the 'comet'</p>	<ol style="list-style-type: none"> 1. Dirt in gel coat. 2. Blowing of gel coat. film during application 	<ol style="list-style-type: none"> a. Ensure a dirt free environment. b. Strain resin to remove dirt. a. Reduce atomizing air to minimum. b. Handle gun to prevent air interfering with lay down of film.
<p>Softness</p>	<p>Soft Gel Coat film.</p>	<p>Soft gel coat film that can be easily matted.</p>	<p>Incomplete cure of gel coat. Check catalyst levels,</p>

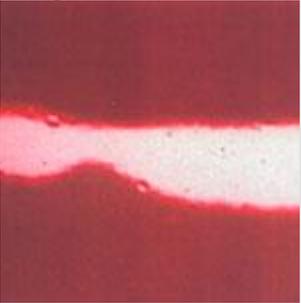
			contaminations and film thickness.
Splatches 	Splatches after de-moulding.	1. Solvent contamination.	Ensure that all solvent has been flushed out of spray equipment lines. For internal mix equipment, ensure that solvent flush line is not leading.
	Splatches after parts are sanded and buffed. Referred to as 'leathery', 'pebbly' or 'chicken skin'.	2. Over-spray.	Do not allow over-spray to accumulate.
		3. Not maintaining a wet line.	Spray laps within 5 minutes
		4. Cure.	The total film must cure as a total homogeneous film rather than several independently cured thin films.

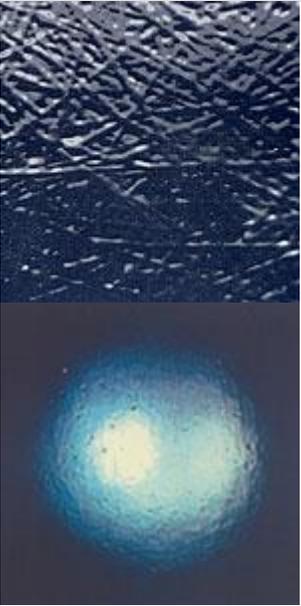
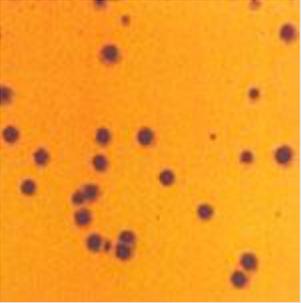
ON CURED GELCOAT PRIOR TO LAY-UP

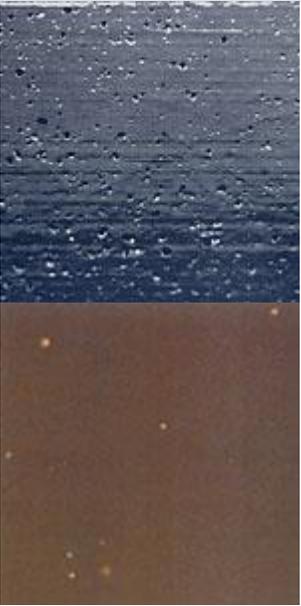
Fault	Description	Cause	Remedy
Craters	Small brown or yellow pools or patches scattered over visible surface of gel coat.	Oil or water in air supply.	Check air supply is clean and dry by spraying air only onto white paper.

ON SURFACE WHEN REMOVED FROM MOULD

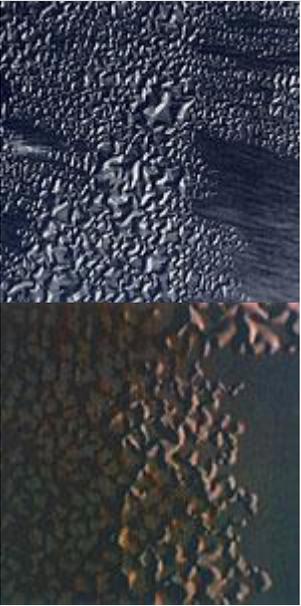
Fault	Description	Cause	Remedy
Delamination	Delamination in spots and large areas.	1. Pattern reproduced from surface of mould.	Resurface mould
		2. Insufficient cure of gel coat. before lay-up.	a. Adjust catalyst concentration and/or temperature. b. Ensure gel coat. laid down as even film.
		3. Gel Coat too thin.	Apply to a minimum thickness of 0.4mm.

		4. Removal from mould while still hot.	Allow to reduce to room temperature after heat assisted cure before removing moulding.
		5. Removal from mould while still under-cured.	a. Increase temperature. b. Allow longer time to cure.
		6. Contamination	Check for dust, solvents, moisture and catalyst getting onto the gel coat surface. Excess mould release wax floating through to the gel coat surface.
		7. Gel Coat too fully cured such as overnight, skin coat, rather than leave on the moulds for long periods of time. Excess mold release wax or wax in the gelcoat.	Check for high catalyst level. Letting the gel coat cure too long.
		8. Unbalanced laminate	Dry fibreglass.
Dimples	Dimples in the gel coat surface.	1. Contamination.	Check for water, solvent or improperly mixed catalyst. Over-spray. Seedy resin. Excess binder on the glass mat.
		2. Other.	Thin laminate or gel coat. Very dry laminate. Pin air entrapped. Post-curing of laminate.
Fibre Pattern	Pattern of glass reinforcement showing on surface.	1. Pattern reproduced from surface of mould.	Resurface mould
		2. Insufficient cure of gel coat. before lay-up.	a. Adjust catalyst concentration and/or temperature. b. Ensure gel coat. laid down as even film.

		3. Gel Coat too thin.	Apply to a minimum thickness of 0.4mm.
		4. Removal from mould while still hot.	Allow to reduce to room temperature after heat assisted cure before removing moulding.
		5. Removal from mould while still under-cured.	a. Increase temperature. b. Allow longer time to cure.
		6. Glass cloth.	Too close to the gel coat. Should have two layers of cured mat or equivalent chop between gel coat and cloth.
		7. Woven Roving.	Too close to the gel coat. Should have three layers of cured mat or equivalent chop between gel coat and woven roving.
		8. High exotherm of laminate.	Cure laminate more slowly. Laminate in stages. Use lower exotherm resin.
Fisheyes 	Small marks that looks like fisheyes	1. Water oil or silicone contamination.	Drain air lines. Check mould release wax. Excess and/or fresh coat of wax is worse.
		2. Dust/Dirt on mould.	Check lubricating materials used within the equipment. Use tack rag.
		3. Gel Coat film too thin.	Use 18 plus minus 2 ml in three passes.
		4. Low viscosity material.	Old material - rotate stock.
Pinholes	Small holes appearing individually or in groups. (may	1. Gel Coat application on surface of the PVA release agent is still wet.	Avoid wax containing silicones (PVA is often superior to wax in achieving an even gel coat.).

	<p>not show until later when they collect dirt)</p>	<p>2. Minute air bubbles on surface of gel coat.</p>	<p>a. Use correctly formulated gel coat. resin. b. Brush carefully, not too vigorously. c. Do not invert mould to prevent dust settling.</p>
		<p>3. Use of solvents to reduce viscosity.</p>	<p>Use correctly formulated gel coat. resin, especially for spray application.</p>
		<p>4. Atomising air trapped in gel coat.</p>	<p>a. Reduce atomizing air to minimum. b. Do not allow spray to blow onto resin film already laid.</p>
		<p>5. Dust particles in release agent or gel coat.</p>	<p>Ensure dust does not fall on mould, release agent or gel coat.</p>
		<p>6. Forced cure.</p>	<p>Allow gel coat. to cure at room temperature. Do not add more than 3% catalyst.</p>
<p>7. Excess catalyst.</p>	<p>Reduce catalyst concentration between 1 and 3% only.</p>		
<p>Pre-release of gel coat</p>	<p>During cure, causing obvious surface distortion and low gloss.</p>	<p>1. Wrong catalyst.</p>	<p>Check for recommended catalyst.</p>
		<p>2. High catalyst level.</p>	<p>Decrease catalyst.</p>
		<p>3. Low catalyst level.</p>	<p>Increase catalyst.</p>
		<p>4. Uneven and/or too thick film.</p>	<p>Check thickness, do not exceed 24 ml, wet. Ensure consistent film thickness.</p>
		<p>5. Gel Coat allowed to cure too long.</p>	<p>Gel Coat should not be allowed to set in the mould for more than a few hours without laminating at least a skin coat. Varies with</p>

	<p>Occurring after cure, observed as visible sharp distinct lines.</p>		temperature - should be laminated same day.
		6. Gel Coat resin solids too low.	Check with manufacturer do not add styrene without their approval.
		7. Uneven cure.	Improperly dispersed catalyst.
		8. Mould release.	Type and amount on the mould.
		9. Clay.	Some clays cause an oily residue and pre-release. Change type of clay. Dust the clay with a very fine powder or over-spray with PVA.
		10. Too long of cure.	Laminate sooner. Don't lap or jar the mould.
		11. Laminate curing too fast.	Check for proper catalyst level. Build laminate in stages.
		12. Wrong type of resin.	Too high in exotherm.
<p>Wrinkling or Alligatoring</p>	<p>Areas of surface with wrinkled appearance. These areas often have poor opacity.</p> <p>Wrinkling of the gel coat resembling alligator hide.</p>	1. Gel Coat too thin and under-cured when back up resin is applied.	Prevent draining on vertical surface by using resin with adequate thixotropic additive.
		2. Under-cure as a result of evaporation of monomer.	Make sure gel coat is not subject to draughts. Avoid very thin films where surface area to volume ratio is high.
		3. Under-cure from other causes.	<p>a. Allow gel coat to cure for longer time.</p> <p>b. Increase catalyst</p>

			<p>concentration. Increase temperature. Use resin of higher reactivity.</p> <p>c. Remove the source of inhibition. Check that tools and equipment are not contaminated with water or solvents.</p>
		4. Raw catalyst.	Check for leaks or over-spray
		5. Solvent.	Do not reduce with solvents
		6. 'Cured' over-spray.	Check for contamination. Maintain a wet line.
		7. Thin gel coat.	Use a minimum of 12 ml wet. Discontinuous gel coat film.
		8. Insufficiently cured gel coat.	Catalyst level too high or too low. Temperature too low. Gel time too long between coats or lamination insufficient. Moisture or contamination in the mould.
Poor Opacity	Light shows through gel coat from reverse side of laminate.	1. Gel Coat too thin.	<p>a. Ensure gel coat applied to recommended maximum thickness.</p> <p>b. Back-up gel coat with darker pigmented lay-up resin (check effect of this on any colour match desired).</p>
		2. Insufficient pigment.	Increase pigment concentration.
Poor Hardness	Soft gel coat which is easily marred.	Incomplete cure of gel coat	<p>a. Adjust catalyst concentration to give satisfactory cure (note: permanent softness can be caused by excess catalyst).</p> <p>b. Maintain higher room temperature between 15 to 35°C.</p>

<p>Blisters or Craters</p> 	<p>Blisters are immediately obvious on removal from mould. Craters may not show until moulding is in service and subject to pressure on surface rupturing the gel coat</p> <p>Water blisters.</p>	1. Void or trapped air pocket in laminate.	<p>a. Take more time in rolling laminate to avoid trapping air bubbles.</p> <p>b. Check resin to glass ratio. Deficiency in resin can often cause air bubbles.</p>
		2. Too long a period between gel-coating and laminating or dirt on gel coat surface, both of which can interfere with bond between gel coat and lay-up resin.	<p>a. Laminate should be laid up sooner to obtain satisfactory bond with air exposed surface of gel coat</p> <p>b. Wipe off gel coat with styrene to remove dirt, which may interfere with bond.</p>
		3. Volatiles from a wet release agent can cause gel coat to lift off mould.	<p>a. Ensure that release agent is not contaminated.</p> <p>b. Allow release agent to dry fully before applying gel coat</p>
		4. Poor adhesion between gel coat and laminate.	Re-formulate using a gel coat free from wax.
		5. Un-reacted catalyst or under-cure.	Check percent catalyst, catalyst over-spraying, mixing and leaks.
		6. Solvent, water or oil.	Check airlines, material and rollers.
		7. Air pockets.	Check roll-out.
		8. Un-reacted catalyst	Check catalyst levels and distribution, film thickness - 18 plus minus 2mils.
<p>Poor Gloss (Hazing)</p>	<p>A foggy appearance to the gel coat instead of the usual gloss.</p>	1. Incomplete cure of gel coat when removed from mould.	Ensure gel coat is fully cured.
		2. Duplication of poor gloss on mould.	Resurface mould.

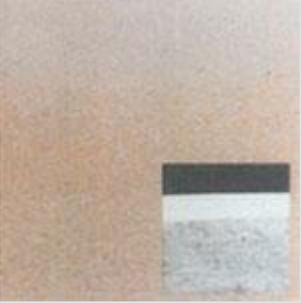
		3. Poorly polished mould.	Clean mould surface, wax and re-polish.
		4. Removal from mould before cooling after elevated cure temperature.	Allow part to cool before removal from mould.
		5. Dirt or dust on mould.	Clean the mould. Time span should be as short as possible between cleaning and gel coating.
		6. Solvent or water.	Check for solvent or water. Drain water traps regularly.
		7. Raw catalyst.	Start catalyst flow away from the mould. Only catalized gel coat should be applied to the mould.
		8. Rough PVA or wet PVA	Check spray technique.

ON SURFACE AFTER AGEING

Fault	Description	Cause	Remedy
Chalking 	Dry, chalk-like appearance or deposit on surface of moulding.	1. Under or over catalysing giving incomplete cure. 2. Surface dirt picked up from atmosphere. 3. Breakdown of surface from prolonged exposure to atmosphere. 4. Poor mould surface.	Ensure correct catalysis. (between 1 and 3%) Clean surface with detergent and water or car polish. Clean surface with detergent and water or car polish. Use only moulds with a smooth, polished surface.
Checking (mud cracking)	Crescent-shaped cracks – appearing singly or in groups.	1. Trapped vapour or incompatible liquid which blows through the gel coat on ageing.	Avoid procedures which may introduce incompatible foreign material into the gel coat (e.g.

		2. Trapped gas pocket held around foreign particles.	water or acetone). Do not allow particles to contaminate the interface between gel coat and lay-up.
Cracks 	Ruptures in gel coat varying in size and length. The pattern of cracks is sometimes a clue to their cause.	1. Stress on gel coat from bending or impact.	Increase laminate thickness or reinforcement.
		2. Gel Coat too thick in relation to laminate.	Adjust gel coat and/or laminate thickness.
		3. Stress built into structure by curing cycle.	Study and adjust curing cycle.
		4. Impact from laminate side.	Check handling and de-moulding procedures. Caution about hammering parts.
		5. Mould mark.	Defect in the mould.
		6. Impact.	Be careful.
		7. Stress due to flexing. Pulled too green, laminate under-cured. Demoulding or handling procedure. Sticking in the mould.	Excessive gel coat thickness. Laminate too thin.
		8. Mould mark.	Defect in the mould.
Crazing		1. Gel Coat too thick.	a. Ensure that gel coat is of even thickness.

	<p>Fine cracks extending in groups or singly over the surface of the gel coat</p>		<p>b. Use correct amount of gel coat resin to give optimum thickness 600-800g/m² is normal.</p>
		<p>2. Use of brittle resin or one containing excess monomer.</p>	<p>Use a specially formulated gel coat resin.</p>
		<p>3. Excessively accelerated cure causing thermal expansion and then shrinkage.</p>	<p>Use tried and proven curing systems and conditions.</p>
		<p>4. Over or under catalysation.</p>	<p>Adjust catalyst concentration in gel coat</p>
		<p>5. Use of solvent in gel coat</p>	<p>Avoid dilution of gel coat with solvent during application.</p>
		<p>6. Exposure of gel coat to a severe chemical environment.</p>	<p>Where unusual exposure can be anticipated use special gel coat resins which have been approved.</p>
<p>Fading and Water Spotting</p> 	<p>A colour variation, usually showing as fading or bleaching. Can appear in areas which have been in contact with water.</p>	<p>1. Incomplete cure of gel coat</p>	<p>Adjust catalyst or temperature.</p>
		<p>2. Insufficient or unstable pigments.</p>	<p>Use standard gel coats and pigment which have been checked for colour stability.</p>
		<p>3. Improper cleaners or chemicals</p>	<p>Do not use strong alkaline or acidic cleaners.</p>
<p>Distortion or Warping</p>	<p>Moulding alters shape.</p>	<p>1. Use of high shrinkage resin.</p>	<p>Use a resin with lower shrinkage.</p>
		<p>2. Differential shrinkage between unreinforced gel coat and reinforced laminate.</p>	<p>a. Use a specially formulated gel coat resin. b. Reinforce the gel coat with surfacing mat. c. Use a thinner gel coat</p>

		3. Unbalanced laminate.	Ensure a balanced sequencing of reinforcement.
		4. Thermal shrinkage.	a. Reduce rate of cure to minimize exotherm. b. Allow each layer to cool before applying next.
Yellowing of gel coat 	Gel Coat yellows rapidly and unevenly when exposed to sunlight and /or heat and moisture..	1. Polystyrene/wax build-up on the mould which has transferred to the part during moulding.	Perform regular mould cleaning program. Do not clean mould with used styrene or reclaimed solvent.
		2. Inadequate gel coat cure.	Check catalyst (bad or old batch) and catalyst level. Use only recommended catalyst and maintain the proper level of catalization.
		3. Contamination.	Look for moisture or oil in air lines or other sources of contamination.
		4. Improper adjustment of gel coat.	The excessive addition of solvents, styrene, inhibitors, accelerators etc. will adversely affect the gel coat's cure.
		5. Cold temperature during application.	Do not apply gel coat at temperatures below 60°F. Permanent under cure may result.
		6. Film cure inhibited by styrene vapours.	Provide adequate air circulation where styrene vapours may collect.

		7. Pre-release faults.	Uneven gel coat thickness, catalization, film gel and cure. Eliminate any pre-release causes.
		8. Excessively hot resin-rich laminates.	Unusually 'hot' laminates may result in permanent under-cure and yellowing of the gel coat.
		9. Resin tearing faults.	Over-spray, excessive film build, flooding or contamination all which can result in pigment separation.
		10. Cleaning the finished part with an alkaline cleaner.	Do not use any strong alkaline cleaners with a pH greater then 9. A weathered gel coat can be yellowed by such cleaners.
		11. Holding gun too close to the mould.	Maintain proper distance.
		12. Spraying in one pass.	Spray in multiple passes.
		13. Insufficient atomization.	Gel Coat must be atomized to fine particles.