

COMPOSITES MANUFACTURING

Manual Composite Layup & Spray Up

SCENE 1.

ML01A, GRAPHIC: FBI warning
white text centered on black to blue
gradient

WARNING

Federal law provides severe civil and
criminal penalties for the unauthorized
reproduction, distribution or exhibition
of copyrighted media.

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SCENE 2.

ML02A, GRAPHIC: disclaimer
white text centered on black to blue
gradient

Always read the operating manual and safety
information provided by the manufacturer
before operating any manual layup & spray up
composite equipment.

Make sure all machine guards are in place,
and follow all safety procedures when
working with or near manual layup & spray up
composite equipment.

SCENE 3.

ML03A, GRAPHIC: EMA/SME screen
white text centered on black to blue
gradient

This program was produced using the technical
resources of the Engineering Materials
Applications Community of SME.

For more information on composites and manual
layup & spray up, please visit
our website at:

www.sme.org

SCENE 4.

ML04A, SME logo open, with music

SCENE 5.

ML05A, composites manufacturing
open, with music
ML05B, peter carey narration

MUSIC UP AND UNDER

NARRATION (VO):

THE COMPOSITES MANUFACTURING SERIES, EXAMINING
THE MATERIALS, TOOLS AND TECHNIQUES USED FOR
COMPOSITES FABRICATION.

SCENE 6.

ML06A, GRAPHIC: Manual Composite
Layup & Spray Up
white text centered on black

NARRATION (VO) :

THIS PROGRAM IS AN INTRODUCTION TO MANUAL
COMPOSITE LAYUP AND SPRAY UP.

SCENE 7.

ML07A, **tape 15**, **15:09:15-15:09:24**
carbon fiber manual layup operation
ML07B, **tape 09**, **09:13:28-09:13:40**
manual spray up operation

NARRATION (VO) :

MANUAL LAYUP...,
AND SPRAY UP ARE WIDELY USED METHODS OF
MANUFACTURING A WIDE RANGE OF COMPOSITE PARTS
AND COMPONENTS.

SCENE 8.

ML08A, **tape 09**, **09:23:50-09:24:00**
zoom out, glass reinforcement in
spray up
ML08B, CGS: Glass
ML08C, **tape 17**, **17:12:45-17:12:53**
carbon fiber being laid up
ML08D, CGS: Carbon/Graphite
ML08E, **tape 19**, **19:01:39-19:01:49**
aramid cloth being folded
ML08F, CGS: Aramid
ML08G, **tape 19**, **19:13:43-19:14:12**
matrix resin material being poured
on glass cloth
ML08H, CGS: Polyesters
Epoxies
Polyimides

NARRATION (VO) :

THE PRIMARY FIBER REINFORCEMENT MATERIALS FOR
MANUAL LAYUP AND SPRAY UP INCLUDE GLASS...,
CARBON OR GRAPHITE...,
AND ARAMID.
THE MATRIX MATERIALS USED ARE TYPICALLY
THERMOSETTING POLYMERS, USUALLY THE
POLYESTERS,
EPOXIES,
AND POLYIMIDES.

--- TOUCH BLACK ---

SCENE 9.

ML09A, CGS: Manual Layup
ML09B, **tape 22**, **22:03:31-22:03:43**
zoom out, glass mat being cut
ML09C, **tape 16**, **16:03:16-16:03:41**
wide aramid reinforcement material
being cut
ML09D, CGS: Utility Knives
Reciprocating Knives
Scissors
Disk Cutters
Power Shears
Rotary Power Cutters
ML09E, CGS: Saws
Gantry Ply-Cutters
Lasers

NARRATION (VO) :

MANUAL LAYUP TYPICALLY BEGINS WITH CUTTING THE
REINFORCEMENT MATERIALS TO SIZE. THIS MAY BE
PERFORMED USING UTILITY KNIVES, RECIPROCATING
KNIVES, SCISSORS, DISK CUTTERS, POWER SHEARS,
ROTARY POWER CUTTERS, SAWS, GANTRY PLY-
CUTTERS, LASERS, WATERJET CUTTING, OR
ULTRASONIC VIBRATORY CUTTING.

Waterjet Cutting
Ultrasonic Vibratory
Cutting

SCENE 10.

ML10A, tape 22, 22:02:03-22:02:10
zoom out, fiber preform
ML10B, tape 21, 21:28:39-21:29:31
preform being produced

NARRATION (VO) :

THE REINFORCEMENT MAY ALSO BE IN THE FORM OF A FIBER PREFORM. THESE PREFORMS ARE PRODUCED IN SEVERAL DIFFERENT MANNERS, WITH THE PRIMARY METHOD BEING PRESHAPING BY SPRAYING CHOPPED REINFORCEMENT AND BINDER ONTO A SHAPED SCREEN FORM.

--- TOUCH BLACK ---

SCENE 11.

ML11A, tape 06, 06:11:20-06:11:38
zoom out, composite processing in mold

NARRATION (VO) :

COMPOSITE LAYUPS AND SPRAY UPS ARE PRODUCED USING MOLDS HAVING THE DESIRED FINISHED PART SHAPE.

SCENE 12.

ML12A, tape 693, 09:16:07-09:16:19
pan, composite material molds
ML12B, CGS: Wood
Plaster
Metal
Composites
ML12C, tape 689, 05:03:33-05:03:41
metal mold
ML12D, tape 06, 06:14:56-06:15:08
composite processing in mold
ML12E, tape 10, 10:07:59-10:08:07
large boat mold

NARRATION (VO) :

MOLDS FOR COMPOSITE MANUFACTURING ARE MOST COMMONLY MADE OF WOOD, PLASTER, METAL, OR COMPOSITES. THE DECISION OF WHAT TYPE OF MOLD MATERIAL TO USE DEPENDS LARGELY ON THE VOLUME OF PARTS TO BE MADE WITH THE MOLD, AND PROCESSING REQUIREMENTS SUCH AS TEMPERATURE AND PRESSURE.

--- TOUCH BLACK ---

SCENE 13.

ML13A, tape 694, 10:06:36-10:06:56
wet layup operation

NARRATION (VO) :

ML13B, CGS: Wet Layup

WET LAYUP IS THE MOST COMMON MANUAL METHOD OF MAKING FIBER-REINFORCED PLASTIC-MATRIX COMPOSITES, WITH THERMOSETTING RESINS FAR MORE WIDELY USED THAN THERMOPLASTIC RESINS.

SCENE 14.

ML14A, tape 14, 14:12:06-14:12:19

release agent rubbed on mold

ML14B, tape 692, 08:05:42-08:05:56

mold being coated with a release agent

ML14C, CGS: Silicone

Polyvinyl Alcohol

Fluorocarbons

Water-Based Solvents

NARRATION (VO) :

BEFORE LAYUP, A MOLD-RELEASE OR PARTING AGENT IS APPLIED TO THE MOLD TO EASE REMOVAL OF THE COMPOSITE PART AFTERWARDS. COMMON RELEASE AGENTS INCLUDE SILICONE, POLYVINYL ALCOHOL, FLUOROCARBONS, AND WATER-BASED SOLVENTS.

SCENE 15.

ML15A, tape 08, 08:21:58-08:22:19

gel-coat being applied to mold

NARRATION (VO) :

A LAYER OF CATALYZED RESIN IS OFTEN APPLIED TO THE RELEASE-COATED MOLD AND ALLOWED TO CURE TO THE GEL OR TACKY STATE BEFORE THE REINFORCEMENT IS APPLIED.

SCENE 16.

ML16A, tape 18, 18:18:44-18:19:05

gel-coat being applied to mold

ML16B, tape 692, 08:07:24-08:07:36

gel-coat being applied to large mold

ML16C, CGS: Flexibility

Blister & Stain

Resistance

Toughness

Weatherability

NARRATION (VO) :

THIS SO-CALLED GEL-COAT IS A PROTECTIVE SURFACE LAYER THROUGH WHICH REINFORCEMENT FIBERS DO NOT PENETRATE. SPECIAL GEL-COAT RESINS CAN IMPROVE FLEXIBILITY, BLISTER AND STAIN RESISTANCE, TOUGHNESS AND WEATHERABILITY.

SCENE 17.

ML17A, tape 19, 19:15:55-19:16:18

zoom out, resin applied impregnating the reinforcement

NARRATION (VO) :

AS THE GEL-COAT CURES, THE REINFORCEMENT MATERIAL, TYPICALLY IN THE FORM OF CLOTH OR MAT, IS PREPARED FOR APPLICATION BY IMPREGNATION WITH LIQUID RESIN. THIS IS

REFERRED TO AS PREWETTING.

SCENE 18.

ML18A, tape 19, 19:17:03-19:17:26
zoom in, prewetted reinforcement
material placed in mold

NARRATION (VO) :

THE PREWETTED REINFORCEMENT MATERIAL IS THEN
CAREFULLY PLACED ON THE COATED MOLD SURFACE TO
MINIMIZE DISTORTION DURING TRANSFER.

SCENE 19.

ML19A, tape 19, 19:19:41-19:19:57
prewetted material hand smoothed in
mold

NARRATION (VO) :

MORE REINFORCEMENT MATERIAL AND RESIN ARE
APPLIED AS NEEDED IN THIS MANNER UNTIL
REQUIRED PART THICKNESS HAS BEEN BUILT-UP.

SCENE 20.

ML20A, tape 13, 13:11:03-13:11:17
prewetted material rolled smoothed
in mold

NARRATION (VO) :

TYPICALLY, THE PREWETTED MATERIAL IS HAND-
ROLLED TO ACHIEVE UNIFORM DISTRIBUTION AND TO
REMOVE ENTRAPPED AIR.

SCENE 21.

ML21A, tape 10, 10:24:03-10:24:21
dry reinforcement placed in mold
ML21B, tape 10, 10:25:56-10:26:12
reinforcement saturated with resin

NARRATION (VO) :

BECAUSE OF THE DIFFICULTY OF HANDLING WET
REINFORCEMENT MATERIALS, THE TECHNIQUE OF
PLACING DRY REINFORCEMENT IN THE MOLD AND THEN
SUBSEQUENTLY SATURATING IT WITH LIQUID RESIN
IS ALSO COMMONLY USED FOR LAYUP.

SCENE 22.

ML22A, tape 17, 17:07:35-17:07:47
aramid fiber being laid up
ML22B, CGS: Prepreg
ML22C, tape 17, 17:02:49-17:03:15
hand layup using prepreg material

NARRATION (VO) :

ADDITIONALLY, MANUAL LAYUP CAN ALSO BE
PERFORMED USING PREPREG, OR PREIMPREGNATED,
MATERIAL. PREPREG COMBINES PARTIALLY CURED
RESIN WITH TYPICALLY CONTINUOUS OR SHORT
UNIDIRECTIONAL FIBERS IN THIN SHEET OR TAPE
FORM.

SCENE 23.

ML23A, tape 01, 01:10:25-01:10:44
prepreg worked around form

NARRATION (VO) :

PREPREG IS TACKY AND WILL MAINTAIN ITS POSITION DURING LAYUP. IN FABRIC FORM IT ALSO HAS SUFFICIENT FLEXIBILITY, OR DRAPE, TO CONFORM TO FAIRLY COMPLEX SHAPES.

SCENE 24.

ML24A, tape 691, 07:05:16-07:05:35
hand lay-up using prepreg material

NARRATION (VO) :

PREPREG MATERIAL, WHICH MAY BE DIRECTIONAL, IS OFTEN LAID IN ALTERNATING CROSS-LAYER FASHION TO IMPROVE OVERALL COMPOSITE PROPERTIES.

SCENE 25.

ML25A, tape 15, 15:06:34-15:06:55
hand lay-up using prepreg material

NARRATION (VO) :

PREPREG REDUCES RESIN CONSUMPTION, AND CAN IMPROVE PART QUALITY BY PROVIDING MORE CONSISTENT CONTROL OF REINFORCEMENT AND RESIN CONTENTS.

SCENE 26.

ML26A, tape 691, 07:25:08-07:25:18
prepreg being pulled from refrigerated storage

NARRATION (VO) :

HOWEVER, PREPREG MUST BE KEPT IN REFRIGERATED STORAGE UNTIL USE, TO PREVENT PRE-CURING.

--- TOUCH BLACK ---

SCENE 27.

ML27A, tape 10, 10:09:28-10:09:45
zoom out, wood placed on reinforcement
ML27B, tape 15, 15:13:14-15:13:22
zoom out, honeycomb

NARRATION (VO) :

ONCE REINFORCEMENT IS PLACED IN THE MOLD, INSERTS MADE OF METALS, WOODS, PLASTICS OR OTHER MATERIALS CAN ALSO BE EASILY PLACED IN POSITION. THESE INSERTS SERVE AS STIFFENERS, FASTENER RECEPTACLES, OR OTHER PURPOSES.

SCENE 28.

ML28A, tape 01, 01:08:29-01:08:56
prepreg wrapped around core

NARRATION (VO) :

TO PRODUCE HOLLOW PARTS, CORES MAY BE USED FOR

MANUAL LAYUP. CORES ARE COMMONLY DESIGNED TO DISSOLVE OR COLLAPSE FOR REMOVAL FROM THE PART AFTER CURING.

--- TOUCH BLACK ---

SCENE 29.

ML29A CGS: Manual Spray Up
ML29B, tape 03, 03:05:04-03:05:30
zoom out, manual spray up
ML29C, tape 06, 06:16:36-06:16:50
zoom out, manual spray up operation

NARRATION (VO) :

THE MANUAL SPRAY UP OF COMPOSITES USES CONTINUOUS ROVING THAT IS CHOPPED, MIXED WITH RESIN AND CURE INITIATOR, AND BLOWN ONTO THE MOLD. AS WITH MANUAL LAYUP, THE MOLD IS COATED WITH MOLD-RELEASE AND MAY HAVE A GEL-COAT APPLIED.

SCENE 30.

continue previous shot
ML30A, tape 06, 06:17:21-06:17:56
zoom out, spray up material being rolled

NARRATION (VO) :

ONCE SUFFICIENT AMOUNT OF MATERIAL IS BLOWN ONTO THE MOLD, THE MIXTURE IS HAND-ROLLED FOR CONSOLIDATION, TO REMOVE TRAPPED AIR, AND TO ENSURE FIBER WET-OUT.

SCENE 31.

ML31A, tape 13, 13:25:26-13:25:54
zoom out, spray up gun during spray up operation
ML31B, tape 08, 08:12:35-08:12:57
zoom out, spray up of large part

NARRATION (VO) :

SPRAY GUNS METER THE RESIN AND INITIATOR WITH THE CHOPPING AND BLOWING OF THE FIBERS. SPECIAL GRADES OF GLASS FIBER, CALLED GUN ROVINGS, CUT CLEANLY, WET RAPIDLY AND CONFORM TO INTRICATE CONTOURS. SPECIAL SPRAYING RESINS MINIMIZE DRAIN OFF AND OTHERS SPEED GEL TIME.

SCENE 32.

ML32A, tape 08, 08:17:51-08:18:05
zoom out, fabric used to build thickness of spray up

NARRATION (VO) :

SPRAY UPS ARE ALSO COMMONLY REINFORCED WITH MAT OR FABRIC TO BUILD THICKNESS AND IMPROVE STRENGTH.

SCENE 33.

ML33A, tape 13, 13:16:42-13:16:51
spray up of large rotating part
ML33B, tape 10, 10:05:34-10:05:48
zoom out, spray up of large boat
hull

NARRATION (VO) :

MANUFACTURING COST FOR SPRAY UP IS LESS THAN
FOR LAYUP BUT RESULTING MECHANICAL PROPERTIES
ARE TYPICALLY REDUCED. SPRAY UP IS USEFUL
MAINLY FOR PRODUCING LARGE PARTS AND THOSE OF
COMPLEX GEOMETRY.

--- TOUCH BLACK ---

SCENE 34.

ML34A, tape 691, 07:19:09-07:19:34
vacuum bag molding operation, vacuum
hose applied
ML34B, CGS: Vacuum-Bag Molding
ML34C, tape 15, 15:27:08-15:27:15
bagged part being placed into
autoclave
ML34D, CGS: Autoclave Molding

NARRATION (VO) :

TO FURTHER COMPRESS AND CONSOLIDATE THE
MATERIAL IN A MOLD AFTER LAYUP OR SPRAY UP,
TECHNIQUES SUCH AS VACUUM-BAG MOLDING...,
OR AUTOCLAVE MOLDING CAN BE UTILIZED.

SCENE 35.

ML35A, CGS: Vacuum-Bag Molding
ML35B, tape 691, 07:17:23-07:17:34
vacuum bag molding operation, film
sealed around mold
ML35C, tape 691, 07:17:45-07:17:57
air valve added to plastic film

NARRATION (VO) :

IN VACUUM BAG MOLDING, A NON-ADHERING PLASTIC
FILM, TYPICALLY POLYESTER, IS SEALED AROUND
THE MOLD AND LAYUP MATERIAL...,
AN AIR VALVE OR VALVES ARE THEN ADDED TO THE
PLASTIC FILM FOR VACUUM CONNECTIONS.

SCENE 36.

ML36A, tape 691, 07:19:59-07:20:19
vacuum created, flattening the bag
against the reinforcement fibers

NARRATION (VO) :

ONCE READY, THE BAG IS DRAWN BY VACUUM AGAINST
THE LAYUP, REMOVING ENTRAPPED AIR, AND
COMPRESSING THE LAYUP MATERIAL AGAINST THE
MOLD FOR GOOD WET-OUT, PART DEFINITION, AND
THE ELIMINATION OF VOIDS. ADDITIONALLY, THE
VACUUM ALSO DRAWS OUT EXCESS RESIN.

SCENE 37.

ML37A, tape 694, 10:02:47-10:02:57
large vacuum mold curing at room

NARRATION (VO) :

temperature

ML37B, tape 691, 07:23:12-07:23:26
vacuum mold transferred to an oven
for curing

ONCE FULL VACUUM IS APPLIED, THE COMPOSITE
MATERIAL IN THE MOLD IS ALLOWED TO CURE AT
ROOM TEMPERATURE...,

OR TRANSFERRED TO AN OVEN FOR CURING. VACUUM
IS USUALLY MAINTAINED DURING THE ENTIRE
HEATING AND COOLING CYCLE.

SCENE 38.

ML38A, tape 694, 10:03:32-10:03:44
zoom out, large vacuum mold part

NARRATION (VO) :

VACUUM BAG MOLDING IS EFFECTIVE IN PRODUCING
RELATIVELY LARGE AND COMPLEX SHAPED PARTS,
INCLUDING THOSE HAVING COMPOUND CONTOURS.

--- TOUCH BLACK ---

SCENE 39.

ML39A, CGS: Autoclave Molding
ML39B, tape 15, 15:21:17-15:21:28
layup being bagged and sealed
ML39C, tape 15, 15:25:32-15:25:45
layup placed under vacuum

NARRATION (VO) :

IN AUTOCLAVE MOLDING, THE LAYUP IS BAGGED AND
SEALED...,
AND THEN EVACUATED OF AIR AND OTHER VOLATILES
UNDER VACUUM.

SCENE 40.

ML40A, tape 15, 15:27:24-15:27:32
layup placed in autoclave
ML40B, tape 15, 15:27:51-15:28:01
autoclave door shut

NARRATION (VO) :

THE LAYUP IS THEN PLACED IN AN AUTOCLAVE AND
EXPOSED TO HEAT AND HIGH PRESSURE. THIS MAKES
THE MOST FULLY DENSE AND STRONGEST COMPOSITE
POSSIBLE.

SCENE 41.

ML41A, tape 14, 14:01:53-14:02:06
part removed from autoclave
ML41B, tape 14, 14:02:51-14:03:17
bag removed from autoclave molded
part

NARRATION (VO) :

BESIDES DEBULKING AND CONSOLIDATION OF THE
MATERIAL, AUTOCLAVE MOLDING CAN BE USED TO
ADHESIVE-BOND ASSEMBLY PARTS AND PROVIDE
CURING AS WELL. CURING PRESSURES CAN RANGE
FROM 50 TO 100 POUNDS PER SQUARE INCH, OR 345

TO 690 KILOPASCALS.

--- FADE TO BLACK ---

SCENE 42.

ML42A, GRAPHIC: Review
white text on black
ML42B, peter carey narration
ML42C, review music

MUSIC UP AND UNDER

NARRATION (VO) :

LET'S REVIEW THE MATERIAL CONTAINED IN THIS
PROGRAM.

SCENE 43.

ML43A, **tape 15, 15:09:15-15:09:24**
carbon fiber manual layup operation
ML43B, **tape 09, 09:13:28-09:13:40**
manual spray up operation

NARRATION (VO) :

MANUAL LAYUP...,
AND SPRAY UP ARE WIDELY USED METHODS OF
MANUFACTURING A WIDE RANGE OF COMPOSITE PARTS
AND COMPONENTS.

SCENE 44.

ML44A, **tape 09, 09:23:50-09:24:00**
zoom out, glass reinforcement in
spray up
ML44B, CGS: Glass
ML44C, **tape 17, 17:12:45-17:12:53**
carbon fiber being laid up
ML44D, CGS: Carbon/Graphite
ML44E, **tape 19, 19:01:39-19:01:49**
aramid cloth being folded
ML44F, CGS: Aramid
ML44G, **tape 19, 19:13:43-19:14:12**
matrix resin material being poured
on glass cloth
ML44H, CGS: Polyesters
Epoxies
Polyimides

NARRATION (VO) :

THE PRIMARY FIBER REINFORCEMENT MATERIALS FOR
MANUAL LAYUP AND SPRAY UP INCLUDE GLASS...,
CARBON OR GRAPHITE...,
AND ARAMID.
THE MATRIX MATERIALS USED ARE TYPICALLY
THERMOSETTING POLYMERS, USUALLY THE
POLYESTERS,
EPOXIES,
AND POLYIMIDES.

--- TOUCH BLACK ---

SCENE 45.

ML45A, CGS: Manual Layup
ML45B, **tape 16, 16:03:16-16:03:41**
wide aramid reinforcement material
being cut

NARRATION (VO) :

MANUAL LAYUP TYPICALLY BEGINS WITH CUTTING THE
REINFORCEMENT MATERIALS TO SIZE.

SCENE 46.

ML46A, **tape 22, 22:02:03-22:02:10**

NARRATION (VO) :

zoom out, fiber preform

THE REINFORCEMENT MAY ALSO BE IN THE FORM OF A
FIBER PREFORM.

--- TOUCH BLACK ---

SCENE 47.

ML47A, tape 06, 06:11:20-06:11:38
zoom out, composite processing in
mold

NARRATION (VO) :

COMPOSITE LAYUPS AND SPRAY UPS ARE PRODUCED
USING MOLDS HAVING THE DESIRED FINISHED PART
SHAPE.

SCENE 48.

ML48A, tape 693, 09:16:07-09:16:19
pan, composite material molds
ML48B, CGS: Wood
Plaster
Metal
Composites
ML48C, tape 689, 05:03:33-05:03:41
metal mold
ML48D, tape 06, 06:14:56-06:15:08
composite processing in mold
ML48E, tape 10, 10:07:59-10:08:07
large boat mold

NARRATION (VO) :

MOLDS FOR COMPOSITE MANUFACTURING ARE MOST
COMMONLY MADE OF WOOD,
PLASTER,
METAL,
OR COMPOSITES. THE DECISION OF WHAT TYPE OF
MOLD MATERIAL TO USE DEPENDS LARGELY ON THE
VOLUME OF PARTS TO BE MADE WITH THE MOLD, AND
PROCESSING REQUIREMENTS SUCH AS TEMPERATURE
AND PRESSURE.

--- TOUCH BLACK ---

SCENE 49.

ML49A, tape 694, 10:06:36-10:06:56
wet layup operation
ML49B, CGS: Wet Layup

NARRATION (VO) :

WET LAYUP IS THE MOST COMMON MANUAL METHOD OF
MAKING FIBER-REINFORCED PLASTIC-MATRIX
COMPOSITES.

SCENE 50.

ML50A, tape 14, 14:12:06-14:12:19
release agent rubbed on mold

NARRATION (VO) :

BEFORE LAYUP, A MOLD-RELEASE OR PARTING AGENT
IS APPLIED TO THE MOLD TO EASE REMOVAL OF THE
COMPOSITE AFTERWARDS.

SCENE 51.

ML51A, tape 08, 08:21:58-08:22:19
gel-coat being applied to mold

NARRATION (VO) :

A LAYER OF CATALYZED RESIN, KNOWN AS A GEL-COAT, IS OFTEN APPLIED TO THE RELEASE-COATED MOLD AND ALLOWED TO CURE TO THE GEL OR TACKY STATE BEFORE THE REINFORCEMENT IS APPLIED.

SCENE 52.

ML52A, tape 19, 19:15:55-19:16:18
zoom out, resin applied impregnating the reinforcement

NARRATION (VO) :

AS THE GEL-COAT CURES, THE REINFORCEMENT MATERIAL, TYPICALLY IN THE FORM OF CLOTH OR MAT, IS PREPARED FOR APPLICATION BY IMPREGNATION WITH LIQUID RESIN. THIS IS REFERRED TO AS PREWETTING.

SCENE 53.

ML53A, tape 19, 19:17:03-19:17:26
zoom in, prewetted reinforcement material placed in mold

NARRATION (VO) :

THE PREWETTED REINFORCEMENT MATERIAL IS THEN CAREFULLY PLACED ON THE COATED MOLD SURFACE TO MINIMIZE DISTORTION FROM TRANSFER.

SCENE 54.

ML54A, tape 13, 13:11:03-13:11:17
prewetted material rolled smoothed in mold

NARRATION (VO) :

TYPICALLY, THE PREWETTED MATERIAL IS HAND-ROLLED FOR UNIFORM DISTRIBUTION AND REMOVAL OF ENTRAPPED AIR.

SCENE 55.

ML55A, tape 10, 10:24:03-10:24:21
dry reinforcement placed in mold
ML55B, tape 10, 10:25:56-10:26:12
reinforcement saturated with resin

NARRATION (VO) :

BECAUSE OF THE DIFFICULTY OF HANDLING WET REINFORCEMENT MATERIALS, THE TECHNIQUE OF PLACING DRY REINFORCEMENT IN THE MOLD AND THEN SUBSEQUENTLY SATURATING IT WITH LIQUID RESIN IS ALSO COMMONLY USED FOR LAYUP.

SCENE 56.

ML56A, tape 17, 17:07:35-17:07:47
aramid fiber being laid up

NARRATION (VO) :

ML56B, CGS: Prepreg
ML56C, tape 17, 17:02:49-17:03:15
hand layup using prepreg material

ADDITIONALLY, MANUAL LAYUP CAN ALSO BE PERFORMED USING PREPREG, OR PREIMPREGNATED, MATERIAL. PREPREG COMBINES PARTIALLY CURED RESIN WITH TYPICALLY CONTINUOUS OR SHORT UNIDIRECTIONAL FIBERS IN THIN SHEET OR TAPE FORM.

SCENE 57.
ML57A, tape 01, 01:10:25-01:10:44
prepreg worked around form

NARRATION (VO) :
PREPREG IS TACKY AND WILL MAINTAIN ITS POSITION DURING LAYUP. IN FABRIC FORM IT ALSO HAS SUFFICIENT FLEXIBILITY, OR DRAPE, TO CONFORM TO FAIRLY COMPLEX SHAPES.

--- TOUCH BLACK ---

SCENE 58.
ML58A CGS: Manual Spray Up
ML58B, tape 03, 03:05:04-03:05:30
zoom out, manual spray up
ML58C, tape 06, 06:16:36-06:16:50
zoom out, manual spray up operation

NARRATION (VO) :
THE MANUAL SPRAY UP OF COMPOSITES USES CONTINUOUS ROVING THAT IS CHOPPED, MIXED WITH RESIN AND CURE INITIATOR, AND BLOWN ONTO THE MOLD. AS WITH MANUAL LAYUP, THE MOLD IS COATED WITH MOLD-RELEASE AND MAY HAVE A GEL-COAT APPLIED.

SCENE 59.
ML59A, tape 06, 06:17:21-06:17:56
zoom out, spray up material being rolled

NARRATION (VO) :
ONCE SUFFICIENT AMOUNT OF MATERIAL IS BLOWN ONTO THE MOLD, THE MIXTURE IS HAND-ROLLED FOR CONSOLIDATION, TO REMOVE TRAPPED AIR, AND TO ENSURE FIBER WET-OUT.

--- TOUCH BLACK ---

SCENE 60.
ML60A, tape 691, 07:19:09-07:19:34
vacuum bag molding operation, vacuum

NARRATION (VO) :

hose applied
ML60B, CGS: Vacuum-Bag Molding
ML60C, **tape 15, 15:27:08-15:27:15**
bagged part being placed into
autoclave
ML60D, CGS: Autoclave Molding

TO FURTHER COMPRESS AND CONSOLIDATE THE
MATERIAL IN A MOLD AFTER LAYUP OR SPRAY UP,
TECHNIQUES SUCH AS VACUUM-BAG MOLDING...,
OR AUTOCLAVE MOLDING CAN BE UTILIZED.

--- FADE TO BLACK ---

SCENE 61.
ML61A, CG, ROLL: credits
white text on black, fade up mid-
screen

Produced By:
Society of Manufacturing Engineers

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SCENE 62.
ML62A, GRAPHIC: disclaimer
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Some machinery in this program had safety
equipment removed to allow better recording of
certain processes.
Always read the safety information provided in
the manufacturers' manual before machine
operation.

SCENE 63.
ML63A, SME logo open, with music