

Course Competencies – Ammonia Operator 1

Index

• Chapter 1 – Process Safety Management – An Operators Perspective	Page 1
○ Chapter 1 – Self Assessment Quiz	Page 48
• Chapter 2: R-717 Safety	Page 51
○ Chapter 2 – Self Assessment Quiz	Page 89
• Chapter 3 – Thermodynamics	Page 93
○ Chapter 3 – Self Assessment Quiz	Page 111
• Chapter 4 – Saturated / Superheated / Subcooled	Page 115
○ Chapter 4 – Self Assessment Quiz	Page 139
• Chapter 5 – The Refrigeration Cycle	Page 144
○ Chapter 5 – Self Assessment Quiz	Page 180
• Chapter 6 – Mastering the Fundamentals	Page 185
○ Chapter 6 – Self Assessment Quiz	Page 272
• Chapter 7 – Evaporators and Low Side Feed Designs	Page 278
○ Chapter 7 – Self Assessment Quiz	Page 331
• Chapter 8 – All About Compressors	Page 336
○ Chapter 8 – Self Assessment Quiz	Page 448
• Chapter 9 – Condensers and Purging	Page 452
○ Chapter 9 – Self Assessment Quiz	Page 507
• Chapter 10 – Practice Tests	Page 510
• RETA Certifications	Page 521
• Sources	Page 534
• Engineering Packet	Page 539
• Closing Thoughts	Page 547

Course Competencies – Ammonia Operator 1

Detailed Index

Chapter 1 – Process Safety Management

The Birth of Regulations – Page 1

What is Process Safety? – Page 4

Process Safety Inspections? – Page 6

Can I Be Interviewed During an Inspection / Audit? – Page 7

Difference Between a Roundsmen / Operator / Mechanic / Technician? – Page 8

Major Ammonia Accidents That Have Affected PSM? – Page 9

The Ammonia Respirator – Page 15

What is my PSM Liability / Accountability / Responsibility? – Page 18

PSM Team – Coaches / Players / Fans – Page 19

The Elements of PSM/RMP? – Page 21

The Acronyms of PSM – Page 22

The Interconnectivity of PSM– Page 23

The PSM Law? – Page 24

Best Practices / RAGAGEP – Page 29

Hierarchy of Controls– Page 31

ARTG – Ammonia Refrigeration Training Guideline – Page 32

Tips for Operators – Page 35

First Few Weeks – Page 35

Shift Turnover – Page 36

Oil Draining – Page 37

Back to the Basics – Valve Turning – Page 40

Buddy Systems – Page 42

Walk Your Pipes – Page 42

Fatigue – Page – 43

Incidental Release vs Emergency Response – Page 44

Course Competencies – Ammonia Operator 1

Join Trade Associations – Page 46

Self-Education / Certification Goals / Career Goals – Page 47

Chapter 2 – R-717 Safety

What is NH₃? – Page 51

How is NH₃ Produced? – Page 52

Where is NH₃? – Page 52

What is NH₃ Used for? – Page 53

What is not Compatible with NH₃? – Page 54

Does NH₃ cause Cancer? – Page 55

NH₃ Behavior Under Atmospheric Conditions? – Page 55

NH₃ – The Inorganic Refrigerant – Page 56

NH₃ Specialized Numbers & Symbols – Page 57

NH₃ Classifications – Page 59

Industrial Grade NH₃ vs. Refrigerant Grade NH₃ vs. Agriculture NH₃ – Page 61

Contaminated NH₃ – Page 62

How much NH₃ should a Facility Have? – Page 64

Reporting Requirements for NH₃ – Page 65

Chemical PPM and Percentage Conversions – Page 67

NH₃ – STEL – Page 71

NH₃ – PEL – Page 71

NH₃ – IDLH – Page 72

Common Injuries with NH₃ Exposure – Page 73

NH₃ Flammability Concern? – Page 74

Finding Small NH₃ Leaks – Page 76

Liquid on Liquids? – Page 78

Water and NH₃ Gas? – Page 79

NH₃ Decontamination? – Page 80

PPE and Tools – Page 81

NH₃ Hoses - – Page 82

www.Ammonia-Training.com

Course Competencies – Ammonia Operator 1

Trapping Liquid NH₃ – Page - 83

Max Storage Capacity of Isolated NH₃ Vessels – Page 85

Other Detailed NH₃ Properties – Page 86

Variations in NH₃ Safety Data Sheets – Page 87

Personal Close Calls with NH₃ – Page 87

Chapter 3 – Thermodynamics

What is Thermodynamics? – Page 93

How Hot is Hot / How Cold is Cold? – Page 96

Temperature and Heat – Page 98

Specific Heat – Page 101

Sensible Heat – Page 103

Latent Heat – Page 103

Sensible Heat / Latent Heat – Water – Page 105

Heat Transfer Methods – Page 106

Materials in Which Heat Transfers – Page 107

Heat Load Example – Page 108

Heat Transfer Tips – Page 110

Chapter 4 – Saturated / Superheated / Subcooled

The Conditions of a Refrigerant? – Page 115

What is Saturation? – Page 116

Simple R-717 P/T Chart – Page 118

What is Superheated? – Page 124

What is Subcooled? – Page 126

Saturation, Superheating, and Subcooling Examples? – Page 127

How to Field Verify Saturation, Superheating, and Subcooling? – Page 129

Measuring Pressure – Page 130

Density and Volumes of Refrigerants at Various Pressures – Page 133

Detailed R-717 P/T Chart – Page 134

Course Competencies – Ammonia Operator 1

Chapter 5 – The Refrigeration Cycle

Major and Minor Components – Page 144

The Compressor – Page 145

The Condenser – Page 154

The Evaporator – Page 157

The Expansion Device – Page 159

The Four Steps of Refrigeration – Page 162

The Five Component Cycle – Page 169

Starting Up a System – Page 170

Cause & Effect – The Beginning of Troubleshooting – Page 173

Chapter 6 – Mastering the Fundamentals

What is a Refrigerant? – Page 185

What is a Secondary Coolant? – Page 187

What is a Single Stage System? – Page 189

What is a Parallel System? – Page 190

What is a Two Stage System? – Page 191

Various Complex Two Stage Systems – Page 194

What is the Cascade System? – Page 197

What is a Constant Pressure Refrigeration System? – Page 199

CPR System Economized / CPR System House Suction – Page 200

What is an Absorption System? – Page 201

What is a Vacuum Cooled System? – Page 202

What is a BFD (Block Flow Diagram)? – Page 203

What is a P&ID (Piping and Instrumentation Diagram)? – Page 204

Pipe Labels? – Page 205

Pipe & Insulation Color – Page 208

Compromised Insulation? – Page 209

Valve Tagging / Equipment Labeling – Page 211

Course Competencies – Ammonia Operator 1

Accessibility to Valves? – Page 212

What is an Isolation Valve? – Page 213

What is a Strainer / Filter / Coalescer? – Page 215

What is a Solenoid Valve – Page 217

What is a Valve Group / Body / Cluster – Page 220

What is a Metering Device – Page 222

What is Flash/Tax Gas – Page 224

What is a Check Valve? – Page 226

What is a Pressure Regulator? – Page 227

What is a Dead Man's Valve – Page 228

How do Vessels Maintain Liquid Level? – Page 229

What is a High-Level Condition? – Page 231

What Causes a Liquid to Boil? – Page 232

What is Lifting a Vessel / Boil Overs? – Page 233

What is Liquid Slugging? – Page 234

What is Hydraulic Shock / Slug / Hammer – Page 236

What is a Compression Ratio / Compression Displacement Ratio? – Page 237

How to Calculate a Compression Ratio? – Page 238

How to Calculate a Compression Displacement Ratio? – Page 239

What is a King Valve? – Page 240

What is a Queen Valve? – Page 241

What is an Emergency Valve? – Page 242

Who is Qualified to do an Emergency Shutdown? – Page 243

What Should be on the Doors to an Engine Room? – Page 244

Who Should have Access to the Engine Room? – Page 246

What PPM Should Alarm/Trip your Safeties? – Page 247

What is a Relief Valve? – Page 248

Where Should the Discharge of the Relief Valves be Plumbed To? – Page 249

What is a Diffusion Systems? – Page 251

Course Competencies – Ammonia Operator 1

What is an EPCS? – Page 251

What is a Fireman's Dump – Page 252

What is a Pump Down / Pump Out? – Page 253

Pumping Down/Out a Valve Groups – Page 255

What is a Venturi Jet Pump? – Page 256

Safe Work Practices – Page 258

Vacuum Pumps? – Page 259

How are Compressors Sized? – Page 262

Calculating CFM – Sizing Compressors – Page 263

How to Calculate Horsepower on a Running Compressor? – Page 264

How to Kilowatts (kW) on a Running Compressor? – Page 264

What are the Affinity Laws? – Page 265

What are Non-Condensable Gasses? – Page 266

What is an HPR? – Page 267

What is an LPR? – Page 268

What are the Types of Oil? – Page 269

What are the Critical Safeties an Operator Get Familiar With? – Page 271

Chapter 7 – Evaporators and Low Side Feed Designs

History of the Evaporator – Page 278

Air Heat Exchange Evaporators – Page 279

Cleaning Air Exchange Evaporators – Page 286

Secondary Coolant Heat Exchange Evaporators – Chillers? – Page 287

Product Heat Exchange Evaporators - Chillers & Freezers – Page 291

Ice Machines – Page 294

Parallel, Cross, or Counter Heat Flow? – Page 296

What are the Types of Liquid Feed Controls for Evaporators? – Page 297

Hand Expansion/Metering Valves – Page 298

Automatic Expansion/Metering Valves – Page 299

Thermostatic Expansion Valves – TXV? – Page 300

www.Ammonia-Training.com

Course Competencies – Ammonia Operator 1

Types of Evaporators by Design – Page 304

Introduction to the DX Design – Page 305

Introduction to the Overfeed Design – Page 309

Introduction to the Flooded Design – Page 315

Low Side Incorporating Multiple Evaporator Feed Designs – Page 319

Introduction to Defrost – Page 320

Gas Defrost Consequences – Page 325

Introduction to Water Contamination in Evaporators – Page 328

Chapter 8 – All about Compressors

Old School Compressors – Page 336

Compression vs Combustion – Page 338

Dynamic Compression – Page 339

Positive Displacement Compression – Page 341

Lifting – Carryover - Slopover - Wet Suction – Floodback – Slugging – Page 342

Compressors – The Focuser of Energy (Heat of Compression) – Page 345

Shaft Seal Compressor / Semi-hermetic Compressors – Page 350

Cruise Control of a Compressor? – Page 352

Reciprocating Compressors Packages – Page 354

Reciprocating Refrigerant Gas Flow – Page 356

Reciprocating Advantages / Disadvantages – Page 357

Reciprocating Compressor Cylinder / Cylinder Sleeve / Piston / Connecting Rod – Page 358

Reciprocating Compressors - Four Stages of Positive Displacement – Page 359

Reciprocating Suction and Discharge Check Valves – Page 361

Reciprocating Compressor Liquid Safety Spring / Yoke – Page 363

Reciprocating Compressor Loaders / Unloaders – Page 366

Reciprocating Compressor Oil Characteristic – Page 369

Reciprocating Compressor Oil Separation – Page 372

www.Ammonia-Training.com

Course Competencies – Ammonia Operator 1

Reciprocating Compressor Direction of Rotation – Page	377
Cooling Reciprocating Compressors – Page	378
Reciprocating Compressors Safeties – Page	379
Reciprocating Compressor Common Failures – Page	380
Screw Compressor Packages – Page	381
Single Screw Compressors – Page	385
Twin Screw Compressors – Page	389
Twin Screw Compressor Rotor Configurations – Page	391
Screw Compressor Direction of Rotation – Page	392
Screw Compressor Gas Flow – Page	394
Screw Compressor Loading and Unloading – Slide Valves/Slide Stops – Page	395
Screw Compressor Economizer/Side Port(s) – Page	401
Screw Compressor Volumetric Efficiency – Page	403
Screw Compressor Oil and Functions – Page	404
Screw Compressor Oil Separation – Page	406
More Troubleshooting – Screw Compressor Oil Separators – Page	415
Screws Oil Cooling Systems – Page	420
Rotary Vane Compressors – Page	431
Scroll Compressors – Page	435
A Deeper Look Into Two Stage Compression – Page	436
Swing Compressors – Page	441
Common Practices when Turning Off Screws & Recips – Page	443
Compressor Drives (Starters) and VFDs – Page	444
Compressor – Daily Rounds – Page	445
Compressor – Major Inspections & Maintenance – Page	446
Testing Safety Cut-Outs – Page	447\

Course Competencies – Ammonia Operator 1

Chapter 9 – Condensers and Purging

Heat Rejection – The Condensers – Page 452

Air-Cooled Condensers – Page 453

Water-Cooled Condensers – Page 456

Cooling Towers? – Page 458

Evaporative Cooled Condensers? – Page 459

Evaporative Cooled Condensers Water Nozzles? – Page 463

Water Sumps with Evaporative Cooled Condensers? – Page 465

Mist Eliminators with Evaporative Cooled Condensers? – Page 467

Fan Types with Evaporative Cooled Condensers? – Page 469

Adiabatic Condensers – Page 472

Dry Bulb vs Wet Bulb – Page 473

Bacteria within the Water – Page 474

Water Treatment – Page 475

De-Superheating – Page 476

Condensation Effects / Implosion Rates – Page 477

Head Pressure / Discharge Pressure / High Side Pressure – Page 479

Floating Head Pressure vs Constand Head Pressure – Page 480

Daily Checks of Condensers – Page 481

Stacked Condensers / Gravity Falling Condensers / EQ Pipes – Page 482

Isolating Condenser Circuits – Page 484

Cycling / Staging Condensers – Page 486

Fouling a Condensers – Page 487

Effects of Non-Condensables? – Page 489

Deeper Look into Non-Condensables – Page 490

How to Determine if a System has Non-Condensables? – Page 494

How the AUTO Purger Works? – Page 499

Purging Shell & Tube / Plate & Frame Condensers – Foul Gas Removal? – Page 504

Course Competencies – Ammonia Operator 1

New Condensers – Passivation Process – Page 505

Condenser Location – Page 506

“If you start learning about something that you know you will need to know you will start to pay attention” – Author Unknown



ARTS

KEEP IT IN THE PIPES

Ammonia Refrigeration Training Solutions - ARTS

www.Ammonia-Training.com